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Proceedings of the Acid Rain Conference Springfield, Virginia April 8-9, 1980

(U.S.) Environmental Protection Agency
Research Triangle Park, NC

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PROCEEDINGS OF THE ACID RAIN CONFERENCE

Springfield, Virginia

April 8-9,1980

Prepared by:

Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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A transcript of the presentations heard at the conference, this document addresses the causes and effects of acid rain and proposed solutions to dealing with the problem. Many charts, diagrams and some photographs are included.

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Dr. Gage: Ladies and Gentlemen, I would like to call this session to order. I am Steve Gage the Assistant Administrator for Research and Development. I am very pleased to welcome you here to this historic meeting on acid rain. During the next two days, we hope that all of us will gain a much better insight into the acid rain problem and learn more about what can be done to lessen its impacts.

As many of you are aware, this meeting follows, by less than a month, an important scientific meeting which was held in Norway. From that meeting we know that our state-of-the-knowledge remains incomplete, but that our state-of-the-knowledge is indeed changing very rapidly. There are now hundreds of scientists in Sweden, Norway, Canada, England, Germany, the United States, and other countries working on this problem. I am convinced that during the next few years we will see a dramatic advance in our understanding of the acid rain problem. I am also convinced from what we have learned, that the problem we will be discussing for the next twenty-four hours is not just a passing fad--it will occupy our attention well beyond this day and probably for most of the decade of the 1980s.

The impacts of acid precipitation affect wide geographical areas in virtually the entire aquatic and terrestrial ecosystem. Acid rain has the potential to cause severe economic damages which can only become more costly should we delay in recognizing its full scope. Most importantly, it is not clear, at this time, whether the impacts of acid rain are, for all practical purposes, reversible. So it is very important that we begin today to establish a dialogue about this problem, and I invite you to join with us in seeking the best approaches for its solution.

Before we begin, I would like to introduce the other members of the EPA team who are here. My cochairman for this two day session is Dave Hawkins, and I would like to introduce Walt Barber; David is the Assistant Administrator for Air, Noise, and Radiation, and Walt is the Deputy Assistant Administrator for Air Quality Planning and Standards. Also I should recognize Bruce Jordan from Walt's office who has worked very hard to arrange this meeting. Also on the program this afternoon are other members of the EPA staff, one is my Deputy Assistant Administrator for Environmental Engineering and Technology, Steve Reznek, and others are Lowell Smith, Ken Demerjian, and Dennis Tirpak who has been coordinating the acid rain research within the Office of Research and Development. I also want to recognize the person to my left, Ray Robinson, the Assistant Deputy Minister of the Environmental Protection Service of Environment Canada. I will hold the introduction of my boss until he begins his opening remarks but let me just make a couple of other procedural comments.

Because many of you are interested in the status of the President's Acid Rain Research Plan, I would like to point out that it has been distributed for review within the Federal agencies and will be available shortly for general distribution to the public. We will be having public meetings on the plan and will have a much greater opportunity at that time to go into detailed comments on research activities.

Last, I would like to call to your attention the procedures for conducting this meeting. In the interest of time and in the interest of a good exchange among all of us, we have asked that only official representatives of the States participate in the discussions. We will certainly welcome written comments and questions from other individuals who would like to submit them. Time permitting, we will ask the panel members and State representatives to address these comments and questions during the course of the conference. With that, I would like to turn the program over to the Administrator of the Environmental Protection Agency, Douglas M. Costle, who will make the opening remarks for the conference.

Mr. Costle: At the risk of being talked back to by the microphones, I will try to speak up. First, I would like to add my welcome to that which Steve Gage just extended both to participants and observers who have come here to discuss strategy for resolving an increasingly serious environmental problem, acid deposition. The widespread interest in this conference and the fact that so many of us are packed into this room says something about the depth of concern about the problem.

I want to take this opportunity to extend a special welcome to the delegation from Canada led by Ray Robinson. Their attendance today continues the spirit of cooperation which has increasingly characterized our relations on air pollution issues.

This conference will be divided into two sessions. Our focus today is to establish a mutual understanding of the causes and the effects of acid rain. We are fortunate to have with us Dr. James Galloway and Dr. Ellis Cowling, two of the most respected experts in this field. Tomorrow we plan to lay on the table some approaches to dealing with the problem. In addition, representatives from five States will address issues from their perspective.

I want to emphasize that the purpose of this meeting is to open a dialogue between the States as well as between the States and EPA. We have left open a lot of time for discussion and I urge that it be lively; that it be unrestrained; and that it be positive and productive. I have two main objectives for this meeting. The first is to establish a mutual understanding of the causes and the effects of acid deposition, the second is to lay out on the table for debate a number of options we are considering to deal with the problem.

Our knowledge of acid deposition is not perfect. As one scientist recently put it to me, the problem has gradually "snuck up" on us in the last few years. Extensive research is now underway by government, by industry, and by independent scientists both in the United States and abroad. For example, last August the President intensified federal research activities by establishing the Acid Rain Coordination Committee to oversee a ten year, one hundred-million dollar budget. Many States have set up monitoring programs to assess the impact of acid deposition within their borders. In several other countries, particularly the Scandanavians, already have compiled some complete and dramatic information about acid deposition affects.

- While there is much we do not know, we do know acid deposition can and has destroyed lake and stream ecosystems killing fish and other water life.
- Lakes in Northern Minnesota, about 200 lakes in New York, and many hundreds of lakes in Canada already are acidified and their fish populations are shrinking or are extinct.

- Headwater streams in the Appalachian Chain from Georgia to Maine are becoming acidified.
- We know some soils are being damaged over time due to leaching of minerals and nutrients.
- We know stone buildings and monuments are eroded more rapidly by acid rain.
- We know that sulfur mist from power plants is contributing significantly to poor visibility in the Northeast which averages now less than eight miles.
- We suspect some important crops can be damaged by acid deposition and that others may be injured by acidified soil.
- We suspect growth of forests may be reduced.
- We suspect that in the long term some drinking water supplies may be contaminated by toxic metals leached from the soil by acid deposition.

What we know and what we suspect about acid deposition tells us that we are faced with a genuine and serious environmental problem. It is a problem which will, if allowed to grow unchecked, carry substantial economic costs. Further research and development of new control technologies obviously must continue, but, in my judgment, we should not let the problem get worse while we learn how to make it better. I have discussed my concern about acid rain with the President and he shares my belief that it is a serious problem and one that must be addressed. He has asked me to propose solutions which I intend to do. In formulating those solutions, I want and I intend to consult widely with various interested groups.

As a practical matter, the only way to reduce acid deposition is to reduce the emissions of sulfur and nitrogen oxides, the pollutants that cause the problem. Among the major sources of these pollutants are utilites and power plants. Last year we set emission standards for new power plants which will prevent them from contributing significantly to the problem of acid deposition, however, there are hundreds of older plants that are either uncontrolled or poorly controlled. Any effective plan to reduce acid deposition will of necessity require reducing emissions from these older plants.

As the Nation backs away from oil and returns to coal for its energy needs, reducing total regional emissions will not be easy but it can be done. I wholeheartedly support coal conversion, it is essential that this Nation reduce its dependence on imported oil. I strongly believe, and have consistently stated publicly, that we can switch to coal and at the same time protect against environmental degradation. As we do so, we must realize that the distribution of coal reserves in this country precludes us from relying simply on low sulfur coal. The welfare of our miners and the economies of our Eastern and Midwestern coal-producing States require that we find ways to use all our coal. The new source performance standards for coal fired power plants allows for just that.

I know many of you are also concerned with the economic effects of being down wind of interstate transport of air pollutants. In reality all States import and export air pollution. When one State is forced to clamp down on sources within its borders to compensate for pollution coming from a neighboring State, its industry unfairly may bear an inequitable share of the cost for dealing with what is in reality a larger regional problem. Moreover, the States margin of economic growth may be unfairly reduced.

In the future, EPA intends to involve itself more directly in these issues. Where States are unable to resolve these inequities among themselves, we will use our authority in favor of the State imposing more stringent controls when it is being adversely affected by another State with relatively lax controls.

Our goals are clear, the best means to achieve them is not. As we chart a course of action, we must face the fact that the Clean Air Act has been used primarily to protect air quality near major pollution sources on a State-by-State basis. The Act has not been fully tested in dealing with regional pollution problems such as acid deposition. However, if we are to do anything in the very near term, we must work within its current structure.

We intend to put the provisions of the law that will allow us to address regional problems to the test. The effectiveness of these provisions remains to be seen. They simply may offer more opportunity for debate and long litigation without providing any real benefits. Although it is still too early to draw definite conclusions we may need, eventually, legislative help.

I am convinced that there will be no obvious, easy, or cheap solutions. There will inevitably be debate over both the significance of acid deposition and the mechanism for its control. Tomorrow Dave Hawkins will moderate a series of discussions with you to explore alternative control strategies.

In closing, I am persuaded that the time has come to make the transition from research to action. My bottom line is to accomplish in the near term a clear reduction in emissions from current levels. As a first step, we must act now to avoid wherever possible, significant increases in emissions of sulfur and nitrogen compounds which are causing acid deposition to increase both in severity and geographical extent. We can then turn to the question of reducing atmospheric loadings from current levels. I look at this conference as a first step toward building substantial agreement between the States on the seriousness of the problem and on the kinds of near term and long term remedial actions that are both appropriate and necessary. Again, I welcome you here and I appreciate the inconvenience to you to travel to Washington for this conference. I consider it perhaps the most important conference that EPA has held since the inauguration of our administration. Steve.

Dr. Gage: Thank you, Doug. The first speaker this afternoon who will discuss the acid rain phenomenon is Professor James Galloway of the Department of Environemntal Sciences of the University of Virginia. Professor Galloway did his graduate work at the University of California at San Diego, and studied with Professor Likens on a postdoctoral fellowship at Cornell University. He is one of the authors of the Council on Environmental Quality Report which led to the President's initiative in the environmental message this past year. He is presently participating in major studies sponsored by both the Electric Power Research Institute in the Adirondacks, the Environmental Protection Agency, and the National Park Service. He is also secretary of the National Atmospheric

Deposition Program. I would like to ask Professor Galloway to take the microphone.

Professor Galloway: Thank you, Steve. After moving from New York to Virginia I am very careful with my "you alls," and "how you dos," and all that kind of stuff, and so if I do not have the appropriate southern twang to my accent I ask my Virginia colleagues to excuse me.

I consider it a great honor to be here. I am going to speak about what I consider the nuts and bolts of acid precipitation. To some of you, it is going to be redundant, but I am really trying to get us all started out on the same foot about what we know about acid precipitation. What are the facts about the phenomenon of increased acidity of precipitation, the causes, where does it come from, and what do we think the trends will be? I have two acknowledgements to make. Really just one, it is to my colleague, Ellis Cowling, I thank him for climbing a step ladder and taping the screen to the mirror so we could show our slides.

I would like to make two definitions before I get started into what we know about acid precipitaiton. The first is: What is atmospheric deposition? Atmospheric deposition is the main transfer mechanism of removing materials from the atmosphere and putting them back on the ground. It is the end result of the adage of what goes up must come down. All the materials that were in the atmosphere that are deposited on the ground, originated on the ground. Because of its primary importance in transferring materials to the ground, it is a major source of not only acids but also nutrients, toxic metals, and toxic organics to systems on the ground. Indeed, the process of atmospheric deposition can supply most of the nutrients or toxic substances to streams, lakes, fields, and forests.

Today we are primarily concerned with wet deposition, rain and snow. That is really just because we are very ignorant about the other processes of atmospheric deposition. We know the most about wet deposition, we know very little about dry deposition, except that it can transport from the atmosphere to the ground as many acids, nutrients, metals, and organics as can wet deposition. So do not be fooled by the focus on wet deposition. We need to know more about dry depostion.

Being a Professor of Environmental Chemistry, I need to talk to you about some chemistry definitions, to make sure we all know what we are talking about when we talk about pH and acidity. The function pH is the negative logarithm of the hydrogen ion concentration. While I do not want you to remember that, what I do want you to remember is that as the pH goes down the hydrogen ion concentration or the concentrations of acids increase. The lower the pH, the higher the acidity. Every time you change the pH from 5 to 4 or from 4 to 3, you increase the hydrogen ion concentration, by a factor of 10. And so, a solution with a pH of 4 has ten times the acidity as a solution with a pH of 5. Note, that down at the lower end of the pH scale, very small changes in the pH of the solution, say from 3.5 to 3.3 would cause very large changes in the hydrogen ion concentration.

Now, by way of definition, we define acid precipitation as rain and snow with a pH of less than 5.6. Why 5.6? Well if you take carbon dioxide in the atmosphere and equilobrate it with atmospheric water vapor, we form a weak solution of carbonic acid, which has a pH of 5.6. We take that to be the lower limit of the natural pH of precipition. Precipitation with a pH which is less than 5.6 is termed acid precipitation.

I would like to talk about acid precipitation on three scales. First of all on the global scale, and then narrowed down into what we know about Northern Europe and then narrowed down to what we know about the Northeastern North America. On a global scale, the annual average map shows two areas of acid precipitation (Figure 1). There are areas in the world where the acidity of precipitation--the hydrogen ion concentration of precipitation--is ten times greater than you would expect it to be in a natural environment. In other words, the pHs are less than 4.6, 4.6 being ten times as acidic as a pH of 5.6.

Now there are some areas of the world where we do not have data, for example Eastern Europe and China. We suspect however, that you would see these same kinds of colors in those areas if we had the data. Well, why here? Why not somewhere else? It turns out, as we will see later, that these areas of the world either have high emission densities of fossil fuel combustion products or are down wind of areas that have high emission densities of fossil fuel combustion products.

Next, I would like to go to Scandanavia and look at temporal trends. The question is: On a temporal scale, how is the pH of precipitation in Northern Europe changed? Using data from the SNSF project, from Norway, and from other countries in Northern Europe and other countries, we are able to make this map of the pH depression in ten years (Figure 2). The area that is bright red is where the pH of precipitation has decreased by 1.5 units, that is greater than ten times the increase in the actual acidity of precipitation, and then the pink, yellow, etc. are just still decreases in the pH but are less dramatic.

In conclusion, the acidity of precipitation has been increasing in Northern Europe. Northern Europe is very fortunate in having a very extensive and intensive data base on the composition of atmospheric deposition over several decades. We in North America are less fortunate. However, from the data that exist, we are able to say, and again this is data from Likens, Cogbill, and others, that in the Eastern U.S. the pH of precipitation has been decreasing over the last approximately 18 years there.

Therefore, the acidity of precipitaiton in the Eastern United States is increasing as a function of time. This applies also to the geographical area receiving acid precipitation. Now, these are measurements. We are reporting on conclusions based on these measurements, and it is what I call the phenomenon of acid precipitation. We are observing this trend and the acidification of precipitation in two large regions of the world.

The next question that is appropriately asked is: What is the cause of these increases in the acidity of precipitaiton? These are the available acids (Figure 3) or as we say proton doners--acid donating materials--that could be found in the atmosphere. Some of the work that was done at Cornell with Gene Likens was to investigate the contribution of these materials to the acidity of precipitation in the Northeastern U.S. A primary conclusion from that study was that precipitation acidity in the Northeastern U.S. (in the Eastern U.S.) is caused by increases in sulfuric and nitric acid with a smaller and irregular contribution from hydrochloric acid. That was a valuable piece of knowledge. We now knew what acids were causing the acid precipitation.

As long as I am talking about acids, I would like to also talk about materials in precipitation. If you were to take a sample of precipitation in the Northeastern U.S. and analyze it for its major anions and cations you would find a lot of hydrogen ions for the cations balanced out by high concentrations of sulfate and nitrate. Those are the component parts of sulfuric and nitric acid. You would also find chloride, phosphate, calcium, sodium, magnesium, potassium, and ammonia. An important point that I want to make here is that I have been talking about hydrogen ions as being harmful in precipitation. There are also beneficial components that are found in acid precipitation. Sulfuric acid and nitric acid in addition to having protons which we view as harmful, also have sulfates and nitrates, which are nutrients. Some forests of the Southeastern United States are sulfur deficient. The increased sulfate concentration of precipitation may be beneficial. Nitrate is often a limiting nutrient in lakes and near shore areas. The increased nitrate concentration of precipitation could be beneficial. However, the hydrogen ions associated with this increased concentration of nutrients are not beneficial. So when you weigh the affects of acid precipitation, it is very important to weigh the harmful effects of the hydrogen ions and the toxic metals and organics to the benefical affects of the nutrients that come along with the compounds.

We have identified the acids, now where do they come from? The possible sources of sulfuric and nitric acid in the atmosphere are fossil fuel combustion, the ocean, natural biogenic processes, increased rate of decay of organic matter, etc. I will not go into the details except to say that the sulfuric acid and nitric acid concentrations of the atmosphere and precipitation are due almost entirely to fossil fuel combustion.

When you burn a fossil fuel you put into the atmosphere sulfur oxide and/or nitrogen oxides. Once in the atmosphere, these are oxidized to sulfuric and nitric acid. You do not directly inject the acids into the atmosphere. You would inject or emit a precursor, the SO_x and NO_x, after that they are oxidized into sulfuric and nitric acid in the atmosphere, then they are scavenged out by precipitation. The atmosphere is cleansed of the acidity, making it less acid, but the precipitation acidity increases. Estimating from the sulfate and nitrate concentrations of precipitation what their relevant contribution is to acidity precipitation, on an annual basis you would come up with a factor of about 2.5 to 1 sulfuric acid to nitric acid.

The question is: Why is precipitation acidic in the Eastern U.S.? Why not in the Western U.S.? This is a map prepared by Brookhaven National Laboratory (Figure 4) showing the points and intensity of SO_2 emission in 1975. The highest intensity of emissions of sulfur and nitrogen are East of the Mississippi River. This does not imply that the Western United States does not have acid rain problems, but in the Western United States the problems are primarily of a local nature. For example, in the area of Southern California where you have a high intensity of automobile use and Seattle where you have some smelters, the aspect of regional acidification of the atmosphere and precipitation is right now, we think, primarily limited to the Eastern U.S., at least to this degree of magnitude. Now, please note, this meeting has been structured around the individual States, and I suspect every State representative here could find a series of dots in their State. We all contribute to the problem, the atmosphere does not know State or indeed national boundaries. Every State, every nation contributes to the problem. It is up to every one of us to assess the affects and look for solutions.

There is another factor beside the patterns of emissions of sulfur and nitrogen oxides in the atmosphere that influence acidity of precipitation. On the annual average, air mass trajectory over the whole of the Eastern U.S., moves from West to East. That is why the emissions are blown to the East and not to the West or why we have acid rain in the East and not in the West. However, there are times and seasons where the air masses do not blow West to East and that is why we see acid rain stretching out into areas of the Midwestern U.S. The transport of acid precipitation and acids is very complex. We can calculate how much goes into the atmosphere, and we think we can calculate how many acids are formed from that. But it is very difficult to calculate where it is going to go. It is very hard to determine where the emissions from one plant or in one State will end up one day, two days, or even a week later.

I would like now to talk about some more temporal trends in the acidity of precipitation on two scales. First, on a seasonal basis, and then on an annual basis. I would like to put some more focus on the relative contribution of sulfuric acid and nitric acid (Figure 5), because, indeed, until we define that, we really do not know what to control. It turns out that in the summer period in the Eastern United

States, we have a maximum in the acidity of precipitation shown by the hydrogen line. It turns out that the maximum of precipitation acidity in the summer in the Eastern U.S. is caused by sulfuric acid, not by nitric acid. Indeed, we could say in the summer, acid precipitation is a sulfuric acid phenomenon.

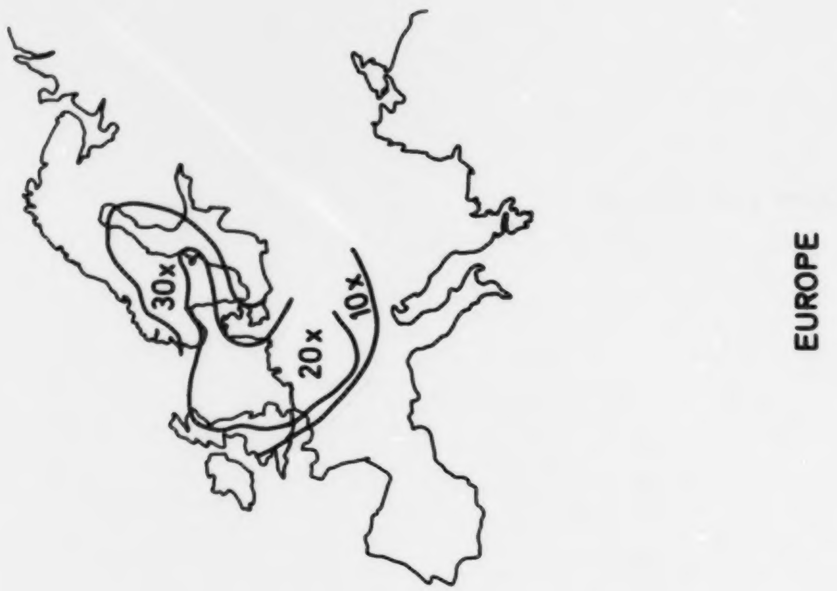
It is very unfortunate that the increase in acidity is coincident with the peak of biological activity from our growing plants and animals. Note that the nitrate concentrations do not change as a function of time, but rather the acidity is really controlled by the sulfur. Well, let us stretch the time scale from seasons to years (Figure 6). In the 1940s and 1950s the emissions of NO_x relative to SO_x were much lower than they are now. Since that time, our emissions of NO_x relative to SO_x have increased dramatically. Saying that another way, nitric acid from this data is becoming more important relative to sulfuric acid. We see this also in the nitrate concentration of precipitation (Figure 7). The nitrate concentration of precipitation is increasing. We believe nitrite acid is becoming more important relative to sulfuric acid as time goes by. This trend will continue unless we are clever in putting controls on the emissions of NO_x in the environment. There has been a good deal of discussion about acidity trends in the atmosphere of the Eastern U.S. Because of the very poor data base that we have, and I hope this will not continue, we really have very few data points where we can say absolutely that the acidity of precipitation is increasing in all areas of the U.S. But, you know, we can get lost in these arguments about how the acidity increased by 10%, 20% in the Northeastern U.S.; or that it increased by 100% in the Southeastern U.S. over the past ten or twenty years. Those are what I consider secondary questions. The main question is: Has the acidity of precipitation increased in the Eastern U.S. through the combustion of fossil fuels? Or to say it another way: If we turned off the combustion of fossil fuels, would we have acid precipitation?

Doug Whelpdale of the Atmospheric Environment Service of Canada and I prepared a sulfur budget for the atmosphere of Eastern North America to address these questions. We looked at all the sources--natural and anthropogenic--and all the removal mechanisms of sulfur to try to answer three questions. What is the anthropogenic relative to natural source of sulfur in the atmosphere? If the answer is that the natural source is very small relative to the anthropogenic, acid rain is clearly an anthropogenic problem caused by combustion of fossil fuels. A secondary question is: What were the removal mechanisms, and our third question was: What kind of transport do we see of sulfur between the two countries?

Figure 8 shows the following: (1) in the United States and Canada, greater than 95% of the sulfur in the atmosphere is anthropogenic. If you turned off the fossil fuel combustion, the sulfur concentrations would drop by about a factor of 10; (2) there are three main removal mechanisms for the sulfur that we put in the atmosphere--dry deposition, wet deposition, and transport out to the ocean; (3) based on this model, every year there are two terregrams of sulfur exported into Canada from the U.S., while we receive 0.7 terregrams. We are a net exporter of sulfur to Canada. Note, that we put about the same amount of sulfur into the Canadian atmosphere as they put into their own atmosphere. So we are not really talking about an interstate problem. It is an international phenomenon that we have to address and be concerned with.

Acid rain is a unique pollution problem. Local and regional impacts will be addressed by Dr. Cowling, but the main point I want to make--the main conclusion I would like to leave with you--is that pollutants originating in one country or State may adversely impact the resoures of another. It is a wet and dry deposition problem, and so we see that the acidification of precipitation is an anthopogenic process caused by the combustion of fossil fuel. The primary acids are sulfuric acid and nitric acid with an acutal contribution to acidity, sulfuric acid being more important than nitric acid but as more time goes by the nitric acid is becoming increasingly important.

Well, scientifically it is very interesting to study these problems of the phenomenon of acid rain. It intrigues me as an atmospheric and aquatic chemist. But relative to the audience we have here, and the severe problems we are forced to address, we have to ask the question: So what? This slide is an introduction into Dr. Cowling's talk about the effects of acid precipitation. You see here that some of the regions in North America that could receive acid precipitation contain large areas that are sensitive to acidification by acid rain. Thank you very much.



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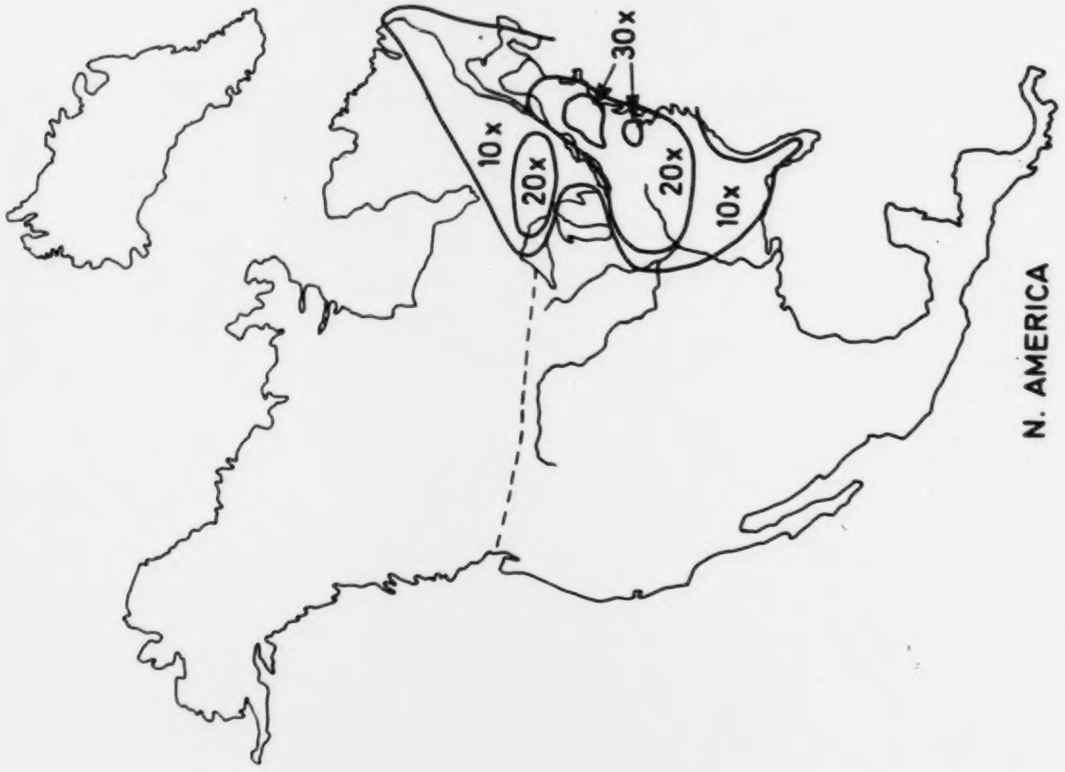
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Hydrochloric, sulfuric, and nitric acids are strongest of several potentially important proton donors in rain and snow

Acid	Relative strength (pK_a)
HCl	~−3
H_2SO_4	~−3
HNO_3	−1
H_2SO_3	1.9
HSO_4^-	2.0
$Fe(H_2O)_6^{+3}$	2.2 to ~3
HF	3.2
Organic acids	3 to 7
$Al(H_2O)_6^{+3}$	4.9
H_2CO_3	6.3
HSO_3^-	7.2
NH_4^+	9.3
HCO_3^-	10.3

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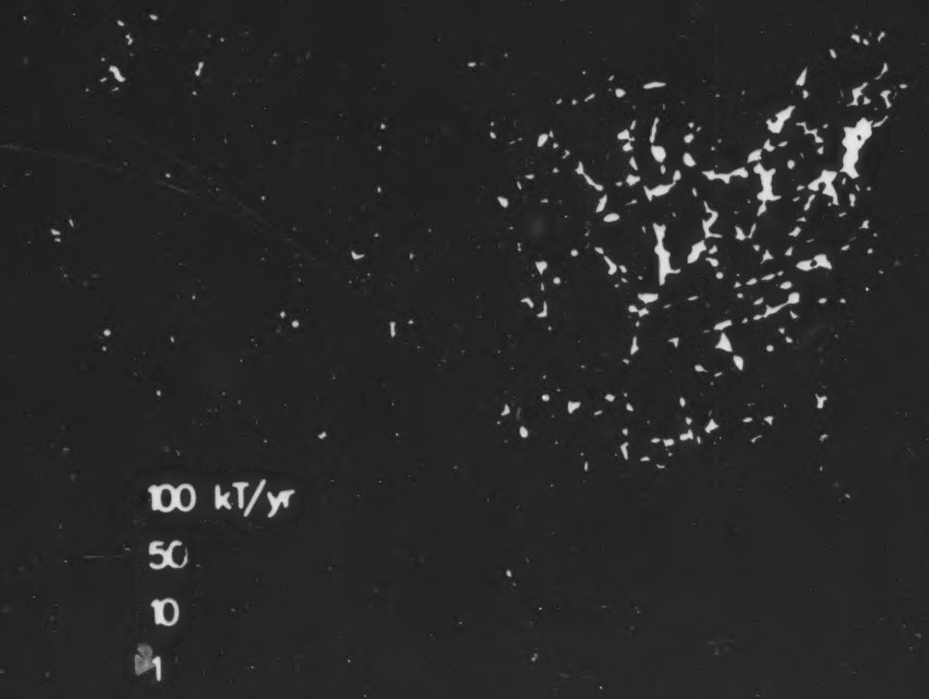
Emissions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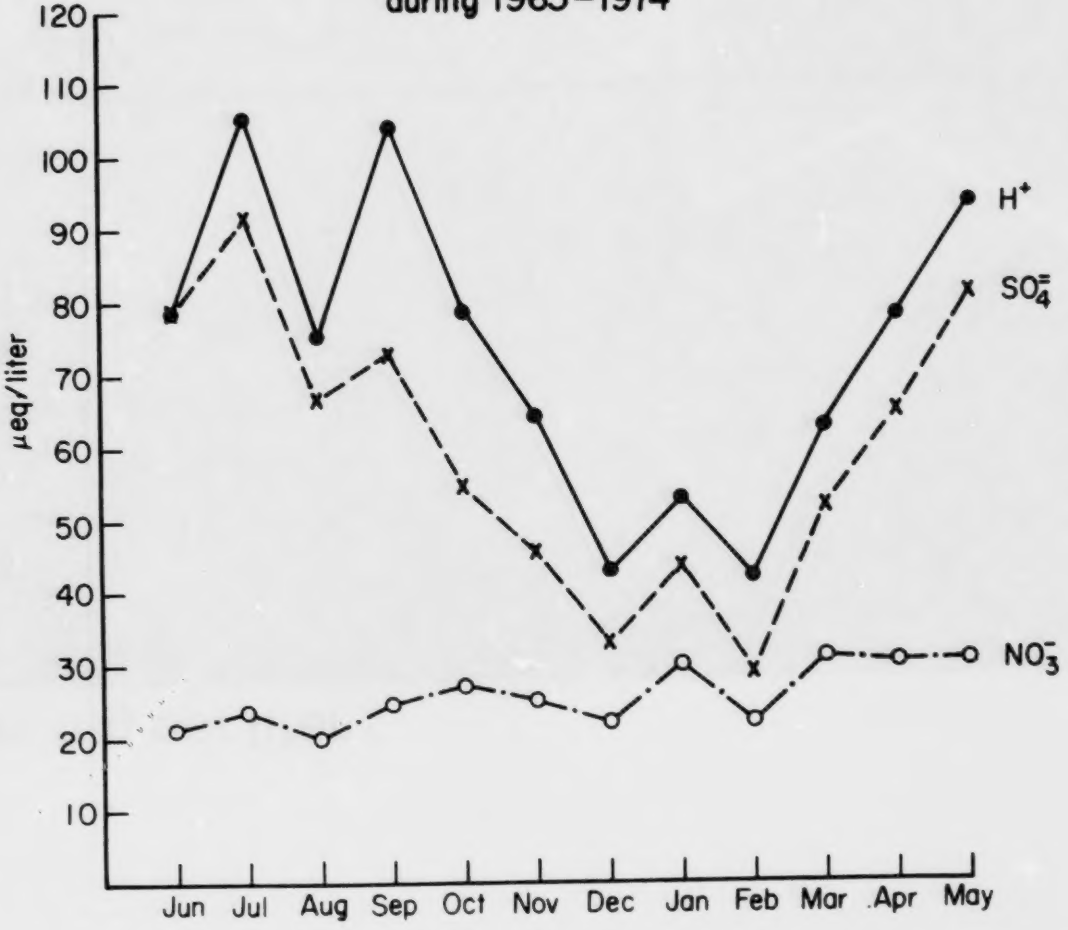
Monthly Bulk Precipitation Values
for Hubbard Brook Experimental Forest
during 1963–1974



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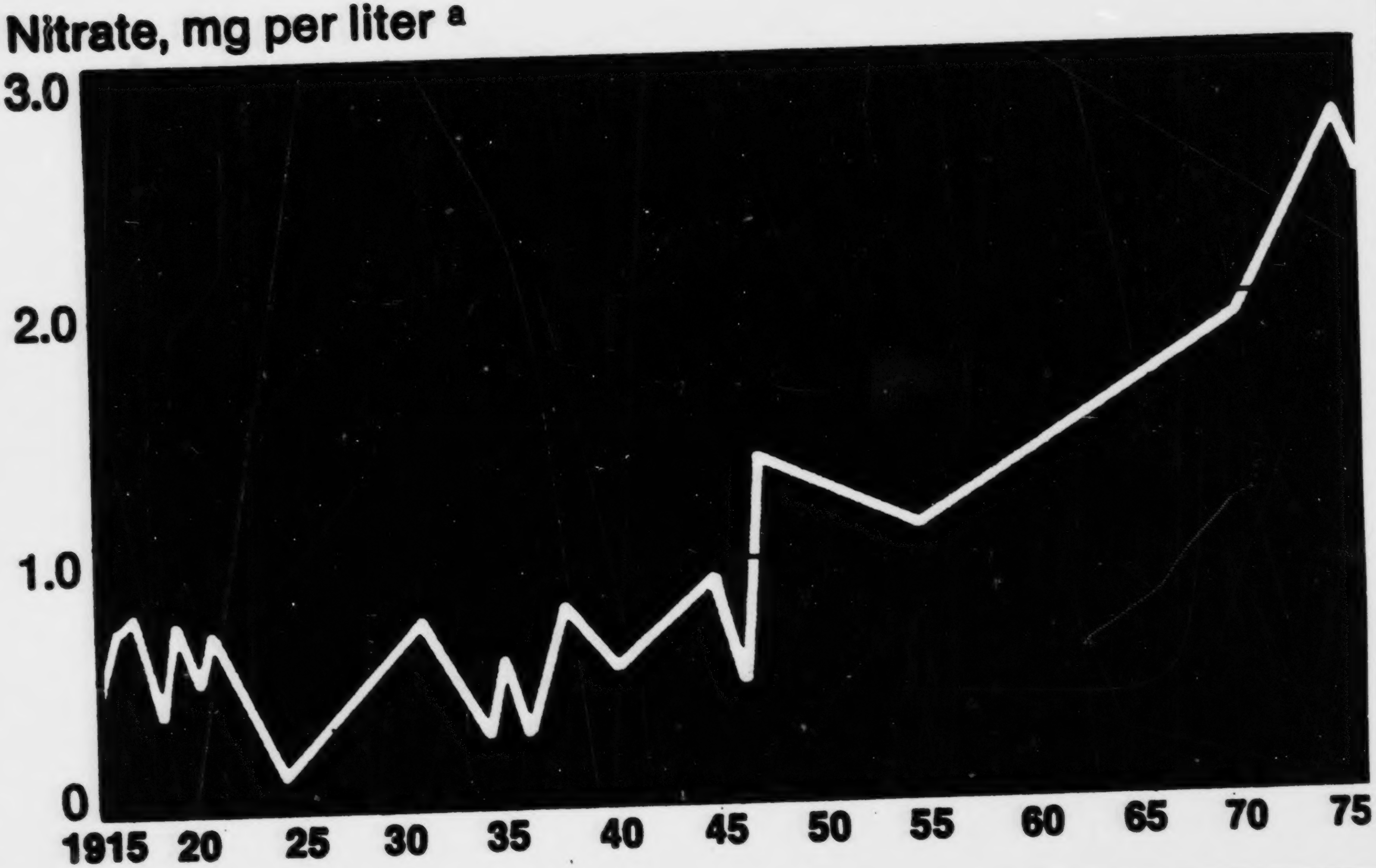
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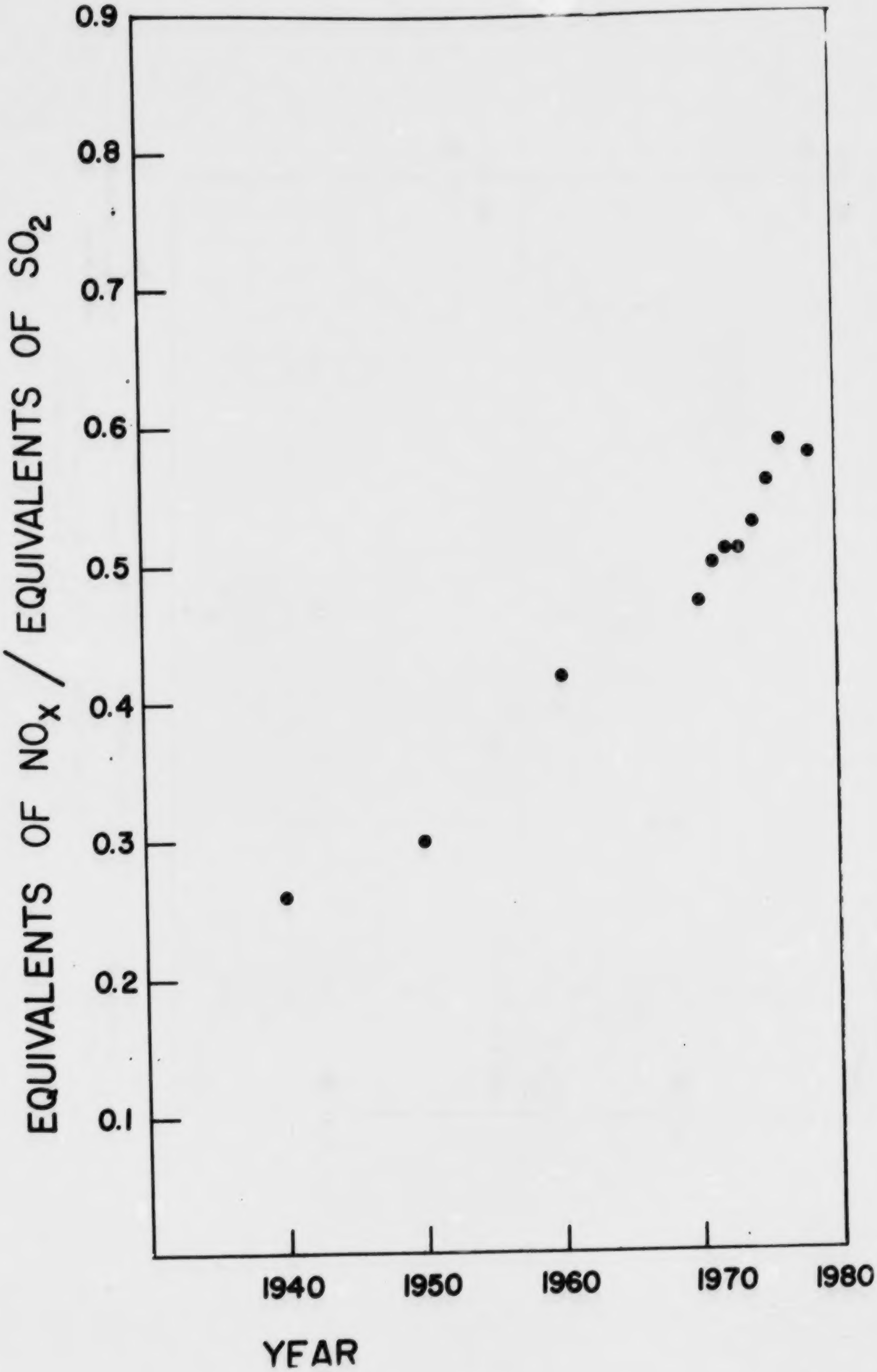

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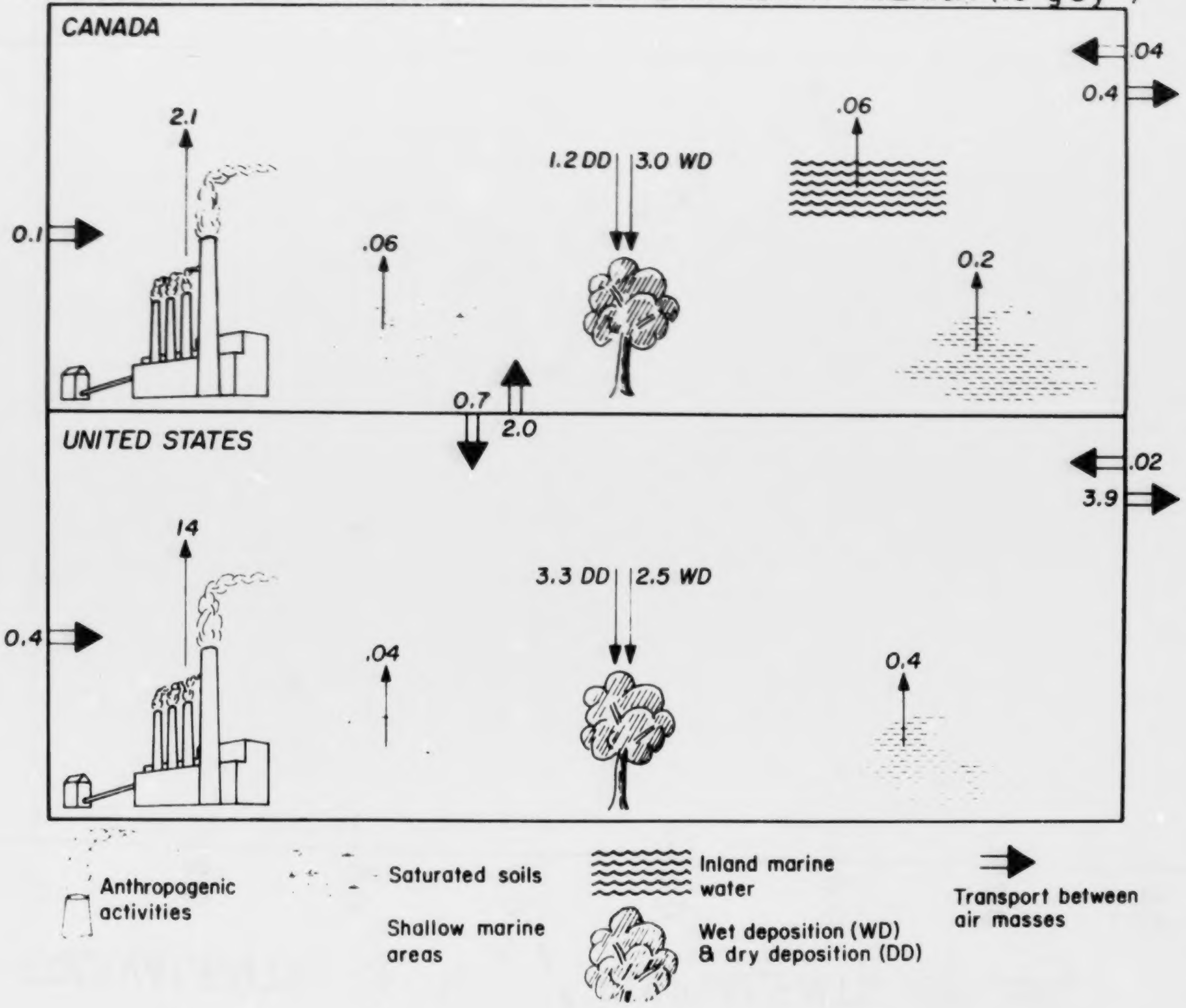
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3.0 WD
.06
0.2
.04
0.4
UNITED STATES
0.4
14
.04
3.3 DD
2.5 WD
0.4
.02
3.9
Anthropogenic activities
Saturated soils
Shallow marine areas
Inland marine water
Wet deposition (WD) & dry deposition (DD)
Transport between air masses

Dr. Gage: Thank you, Professor Galloway. The next speaker is Dr. Ellis Cowling who is the Associate Dean for Research in the School of Forest Resources at North Carolina State University and also Assistant Director of the North Carolina Agricultural Research Service. Dr. Cowling received a doctoral degree from Uppsala University in Sweden in plant physiology. It was there that he first became acquainted with the acid rain problem. Since then he has played a very dominant role here in the United States in attempting to bring this problem to our attention. He has contributed many professional publications in this area and is currently serving as the Chairman of the National Atmospheric Deposition Program. Ellis, take it away.

Dr. Cowling: Thank you, Steve. It is obvious from the participation in this meeting that acid precipitation is approaching a new level of public consciousness in many parts of the United States and Canada. This is an exciting development for many of us who have been concerned about the ecological effects of acid precipitation. It has been particularly satisfying to Dr. Svante Oden, the soil scientist at the University of Uppsala who first called the world's attention to the long range transport of air pollutants and has given you an introduction to the chemistry and meteorology of acid precipitation. It is my duty to introudce you to the ecological effects of acid precipitation. Let me begin my presentation with the same slide that Jim used to begin his (slide 1).

It is important that we understand that acid precipitaiton is only one special feature of the general phenomenon of atmospheric deposition--the transfer of matter from the atmosphere into ecosystems--into lakes, streams, forests, and fields. As Jim emphasized, both wet and dry deposition are exceedingly important. You will remember in his slide showing the total atmospheric deposition in the United States that sulfur deposition dry, exceeded sulfur deposition wet. So let me emphasize again that we are concerned not only with wet but also with dry deposition.

Next let us look at acid precipitation in the context of how plants grow (slide 2). This slide shows the essential chemical elements that it takes to grow a plant. Chlorine has been added recently so that there are now 16 essential elements that are required by plants to grow. All 16 are distributed abundantly in the atmosphere. All 16 can be taken up by the foliage as well as by the root system of plants.

We must all understand that atmospheric deposition is a mechanism by which plants obtain both beneficial nutrients and injurious substances of which acids are only one example. Jim also showed this third slide which illustrates the extent to which nitrate ions in precipitation have become progressively more abundant in recent years (slide 3). At Ithaca, New York, from the early part to the latter part of this century, a four-fold increase took place in the content of rain and snow. Nitrate ion is an essential nutrient for the growth of plants. This slide shows that nitrate ion is being provided in four times the abundance it was during the early part of this century. Nitrate ion is a fertilizer element. It helps plants grow. But the nitric acid that gives rise to nitrate ion also provides hydrogen ions. Thus, to understand acid rain, we must understand the balance between beneficial and deliterious effects. A few years ago I remember making the remark in a meeting in Washington, that plants had two root systems, one stuck in the air, and the other stuck in the ground. Eville Gorham heard my talk and later reminded me that this was not an original statement--in fact, the same idea was enuncisted by Rober Hooke in the year 1671 (slide 4).

Where do all these substances in the atmosphere come from? This next series of slides shows the great variety of places from which they come. They come from various natural sources. They come from decomposing organic matter in wet lands and bogs (slide 5). They come as air-blown dust from desert regions of the world (slide 6). They come from volcanos such as Mount St. Helens in the State of Washington. They also come from various man-made sources such as power plants (slide 7). Power plants are the predominant source of acid-yielding substances in the United States. They also come from metal-smelting operations (slide 8). This slide shows the famous Sudbury Smelter which injects more sulfur into the air than any other point source in the world. Floyd Elder took this picture some years ago. As you can see here, the emissions from this stack can be seen as a very visible plume for very long distances, up to 200 miles, under the right meteorological conditions. Slide 9 shows the City of Chicago on January 24, 1972. Hopefully, EPA's efforts to clean up Chicago have made it so that this kind of brown smudge occurs less frequently in 1980 than it did in 1972.

Atmospheric deposition also originates in agricultural operations. Slide 10 shows a livestock feeding operation in Colorado which provides an abundant and rich array of ammonia and amine compounds that are dispersed over the landscape. Slide 11 shows a farm in Georgia, a turkey operation. It is no surprise that the grass is green here. The grass is being fertilized by an abundance of volatile ammonia and amines--

valuable nutrients which are used by the grass to grow green. But these same substances also are used by algae that grow in farm ponds and therein make a nuisance of themselves.

Atmospheric deposition also comes from agricultural and forest burning operations. Agricultural burning is an important plant-disease management tactic in the Willamette Valley of Oregon (slide 12). Atmospheric deposition also comes from controlled burning operations and wild fires in North Carolina (slide 13).

All these substances from all these different sources are mixed and chemically transformed in the atmosphere. They are also transported over great distances to many different regions of North America (slide 14) in every season of the year. When they eventually return to the earth, they are deposited in two general places--onto the vegetation and soils of the landscape or onto surface waters. If the rain or snow does not fall directly into a surface-water system, it will fall first onto the landscape and then drain into the steams or lakes of the area.

Slide 15 is one of Svante Oden's slides. It illustrates the importance that must be attached to the mobilization of metal ions by acid precipitation--some of these ions are nutrients such as calcium or magnesium while others are toxic metal ions such as aluminum or mercury. These metal ions are transferred from the soil into water systems where fish or aquatic life in a stream or lake are the recipients. In essence, the lake tends to integrate the chemistry of the entire watershed. As we will show later, the ground water systems of the earth also integrate not only the watershed but the entire morain, or clay, or sandy-soil system that covers the earth and the vegetation that is supported by it. When we think about the effects of acid precipitation on aquatic ecosystems, it is very important that we understand these integrating relationships between the chemistry of precipitation and the chemistry of the atmosphere, the vegetation, the soils, and the bedrock of the area in which the precipitation falls. Slide 16 shows these integrated chemical relationships very clearly over a long span of years. These data are for the Hinkley Reservoir near the City of Utica, New York. It is one of the most complete data bases we have in America showing the changes in aquatic chemistry in a whole drainage basin. The lower curve is for the alkalinity of the water system. In a crude sense alkalinity is the opposite of acidity. These measurements were made every week from 1924 through the present day. What a valuable data base this is, because it show us what the changes have been in the chemistry of deposition into this particular reservoir. Notice that in this particular series of years there was a very rapid decrease in alkalinity whereas there was practically no change for almost a decade. But in this period of years a very rapid increase in alkalinity took place and finally in this series of years a very rapid decrease in alkalinity took place. Thus, over the long term of this fifty year span of time, a very substantial decrease in alkalinity took place in this municipal reservoir. We have every reason to believe that these changes in alkalinity were caused by the deposition of acid substances in rain and snow about which Jim Galloway spoke about earlier.

Now what are the consequences of acid deposition into a lake? It must be understood that not all precipitation comes down as rain, some of it comes down as snow. In Northern New England you might be able to take a picture such as this (slide 17) but you certainly could not in my

State of North Carolina except perhaps on the top of Mount Mitchell. It is important to understand that unmelted snow accumulates air pollutants. If the snow pack does not melt during the entire winter season, the soluble pollutants that are in that snow will be held all winter long and then come out into the local stream waters in one immense pulse--a gush of polluted melt water. The fish kill shown in slide 18 is a consequence of that kind of pulse--a shock to the aquatic life that lives in the stream or in the lake.

In addition to these shock effects, there are also other more insidious effects that take place slowly and without the catastrophic visible impacts that a fish kill shows. Slide 19 shows the roe of brown trout. When these little eggs hatch, they turn into little fingerlings that look like this (slide 20)--fish fry. This slide shows what a normal brown trout fry looks like when it hatches in lake water with a pH of 5.5. Slide 21 shows what they look like when the hatch at pH 5.0. Notice they have difficulty assimilating the yolk sac in this case. Slide 22 shows what the fish fry looks like when they hatch at pH 4.5. None of these will survive. The phenomenon of progressive acidification shown in this series of slide leads to a progressive failure of recruitment. When this process continues year after year, the population of fish goes to extinction.

To show what recruitment failure means in summary form, let me show slide 23. The bottom scale on this slide is pH. The vertical scale is the proportion of lakes that have no fish, sparse populations, or good populations of fish. Notice that the more acid the lake, that is, the lower the Ph, the more frequently the lake will have no fish or only sparse populations. The more nearly neutral the lake water is, the greater will be the likelihood that the lake will have good populations of fish.

Many of you in this room are concerned with the protection of environmental quality in your respective States. But what can you or we do about acid precipitation? Doug Costle has indicated his determination that we should not increase and, if possible, diminish our emissions of the air pollutants that cause acid rain--SO_2 and NO_x. This next slide was originally designed for another purpose but we can use it to show something of what we can gain by decreasing the rate of loading of sulfate into a lake. Notice that the bottom scale shows sulfate loading to lake water and the resulting pH is shown on the vertical axis. The two curves show that the more heavily you load a lake with sulfate, the more rapidly you will change the pH. But if you decrease the rate of loading of sulfate you will increase the time it will take to achieve a chemical "titration" of the lake. So one of the things we would gain by diminishing emissions is to gain time with which to more completely understand the chemistry, to understand the effects on the aquatic life, and to understand the kinds of ameliorative pollution-control stategies that may be desirable for us to take in the interest of protecting aquatic life.

These next two slides show some ideas that Dr. Carl Olof Tamm of Sweden and I presented for the first time at the Ohio Conference on Acid Precipitation in May of 1975. At that conference we talked about possible effects of acid rain on vegetation. This word possible is a "weasle word" which we scientists put in when we think something might happen but we have not yet proved it. Slides 25 and 26 each show four possible effects. The first item is leaching of mineral elements from foliar organs. In 1975 we thought this might occur; it has now been established to occur. The second item is leaching of organic compounds from the foliar organs; we now know that this also occurs because it has been demonstrated both in field and in laboratory experiments. The third item is erosion of protective wax over the surface of leaves. This effect has been demonstrated not only in this country but also in Britain. The fourth item, interference with normal guard cell functions, has been detected in laboratory experiments.

Slide 26 shows four other possible effects. The first is direct injury to meristematic or unsuberized succulent tissues--the tender shoots that develop in young plants. The second item is alteration of plant exudation processes with attendant changes in the kinds of organisms that live near roots and on leaf surfaces. The third item is alteration of the integrity of cell membranes due to the deposition of acid substances. The last item is alteration of resistance or susceptibility to foliar, soil-borne, and other plant pathogens. All of these effects were postulated in 1975 and by 1980 they all had been proven to occur in at least one experimental plant.

Let me show you some of these effects. If you apply an acid solution to plants as Mark Decot did in our laboratory some years ago, it is possible to induce little spots which show injury to the leaves (slide 27); but you have to apply a pretty strong acid solution to do that (pH 2.7). At much more mildly acid conditions you can also induce the premature senescence of older needles on pines (slide 28). These older needles are supposed to remain functional in photosynthesis but they cannot do this very well when they turn brown. These older needles turned brown after only a single year of function rather than after the two or three seasons of function that is customary with this type of pine. Slide 29 shows a condition in Yellow Delicious apples which, in so far as we know, is not due to acid rain; this "russetting" is induced by other substances, as yet uncharacterized in terms of their chemistry, in both dry and wet deposition. If you were to shelter apple trees in a plastic enclosure or use a simple furnace filter to remove the particulate matter you could decrease this kind of injury. You can also further protect them from precipitation (slide 30); but it is pretty hard to grow apples in an economic way without them ever being rained on.

Slide 31 is one that my former student, David Shriner, used to demonstrate the erosion of epicuticular waxes. Let me show you the detail of this. Plate B shows the platelets of wax that accumulate on the oak leaf. These platelets of wax are very easy to see when they are not eroded. This plant has never been watered over its foliage. In plate C you will see that the platelets of wax are more rounded, it is much more difficult to see texture in the wax. This plant received simulated precipitation of 6.0. In plate D you see wax platelets that are extensively eroded. Much of the wax was removed by simulated acid precipitation of pH 3.2. David Shriner did not know that this erosion would cause an increase in drought susceptibility but he thought so. At a meeting in Norway about two weeks ago a scientist from Scotland reported that he had observed a decrease in resistance to water loss in leaves subjected to simulated acid precipitation. I consider the erosion of surface waxes one of the most likely general effects on crop and forest production. If the protective wax surfaces are removed, it is likely that this will cause an increase in susceptibility to drought, not actual damage by the acidity, but increased susceptibility to drought.

Acids in precipitation also have been shown to leach valuable nutrients from the root zone of plants so that they end up so deep in the soil that they are inaccessible to plant roots (slide 32). Acid precipitation also has been shown to inhibit the formation of nitrogen fixing bacterial nodules on legumes (slide 33). This research also was done by David Shriner in our laboratory in Raleigh. He found the same inhibiting effect on both soybeans and kidney beans.

Here is another effect of air pollution--substances in the air that interfere with normal visibility. All of you who have traveled the Blue Ridge Parkway have seen the logo shown in slide 34. The Peaks of Otter are the symbol of that marvelous parkway which we all have enjoyed in the Blue Ridge Mountains of Virginia. Slides 34 through 37 were provided by Dr. John Skelly of the Virginia Polytechnic Institute. They show what the Peaks of Otter look like in reality at three different concentrations of oxidant in the atmosphere. We do not know that the oxidants were the cause of the haze but we do know there is a correlation between oxidants and poor visibility. Slide 35 shows what the Peaks of Otter looked like at two parts per hundred million in the atmosphere. Slide 36 shows what they looked like at 12, and slide 37 shows what they looked like at 16 part per hundred million in the atmosphere. Obviously it is far more enjoyable to visit the Peaks of Otter when there are 2 rather than 16 pphm of oxidant in the atmosphere. The frequency with which we have days when there are only 2 pphm in the atmosphere are decreasing year by year. The question for us is: How much do we wish to allow our children to enjoy these kinds of scenic vistas in the national parks?

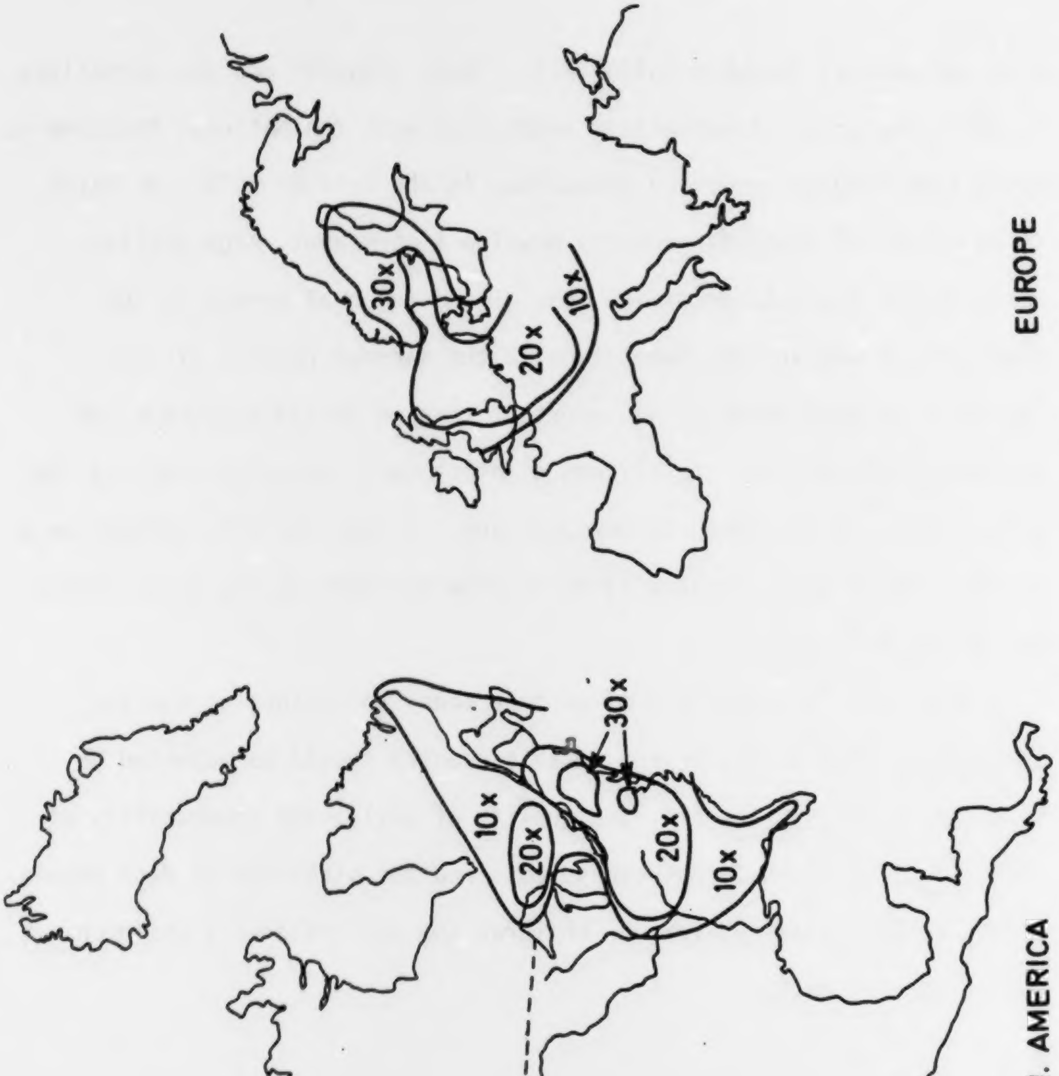
Doug Costle referred to the erosion of monuments by acid precipitation. Slide 38 shows a very famous madonna that adorns a castle in Germany. The madonna was created in 1702. The picture on the left was taken in 1908 after 200 years. The statue is clearly a madonna and adorns that building with grace. The second picture was taken by Winkler in 1969. The statue may still be discernable as a human form but it is no longer a madonna. The cultural heritage of German society is slowly being eroded away. The statue suffers, no doubt, because of both sulfur in the air and sulfur in precipitation.

One of the most intriguing and perhaps one of the most worrisome of all effects that we now know due to acid precipitation is illustrated in slide 39. It shows the pH of a number of wells in Western Sweden. Notice that the pH of the ground water ranges from 4.0 to 8.0. Notice also that 13 percent of the nearly 1600 wells which were sampled were owned by persons who complained about corrosion problems. When the acidity of ground water changes, the acidity of well water changes and that means that human beings and livestock are drinking water which is substantially more acid and in many cases substantially richer in metal ions than usual. Plese understand that ground water has percolated over foliage, it has percolated through the humus layer, it has penetrated deep into the soil, and sometimes deep into the morain or other sedimentary materials that make up the aquasphere--and still the water may be only pH

4.5. There appears to be no buffering capacity left in the soil system. This is a very serious and perhaps one the most insidious of all the effects we have seen. At least in certain local areas, acid precipitation apparently can affect the quality of drinking water. Slide 40 is an attempt on EPA's part to sum up what we know and what we think we know about the effects of acid precipitation. The first effect is the acidification of lakes, rivers, and ground waters resulting in damage to fish and other components of aquatic ecosystems. That is established, but acidification also leads to item 2--release of metal ions from soil. Notice that the word "possible" is used three times--in item 3, item 4, and item 6. The word "possible" means that we think it occurs, but we have not been able to prove it conclusively. We think acid precipitation may reduce forest productivity and we think it may also cause damage to agricultural crops. There is certainly deterioration to man-made materials. Notice that the last item say "possible contamination of drinking water supplies by metals being released from soils and from pipelines". After the international conference on acid precipitation in Norway two weeks ago, we can cross out the word "possible" in item 6. It is now established that acid precipitation can cause contamination of drinking water.

Steve Gage mentioned the President's environmental message and the initiation of the President's Acid Rain Coordinating Plan. Steve is one of the two cochairmen of this committee. Rupert Cutler of the Department of Agriculture is the other cochairman. I think it is a very encouraging thing that Jimmy Carter has provided a measure of leadership for us in seeking to deal in a constructive way with the problem of acid precipitation over the next ten years. In conclusion, I should like to leave you with two general thoughts (slide 41). These thoughts are the objectives to which the group of scientists associated with the National Atmospheric Deposition Program committed themselves in the Fall of 1975. We think it is essential that this country develop a permanent, high quality monitoring network to determine spacial and temporal trends in the chemistry of wet and dry deposition in the various regions of this country. We also think it is important that we should encourage and coordinate research on the effects of atmospheric deposition on all the things that you have seen in these slides. I hope you will reflect in a serious way on these various kinds of effects--that is the major reason why we are here today.

It is important for all of us here today to reflect on how the systems by which we use energy in this country should be adjusted so that the quality of the air, the quality of soils, the productivity of our agricultural and forest ecosystems, and the stability of fish populations can be maintained for our children and our children's children. I thank you very much.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EUROPE
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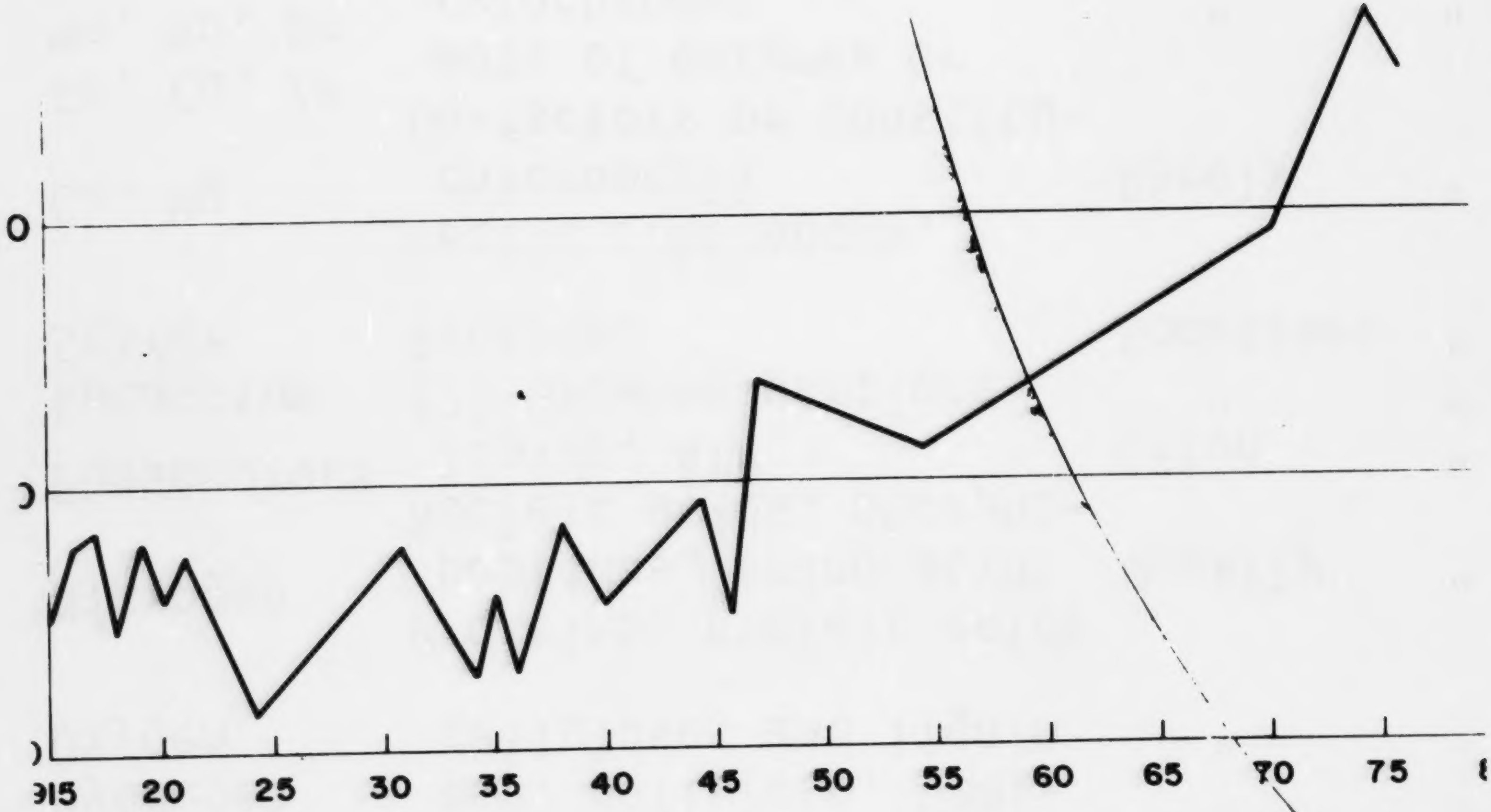
N. AMERICA

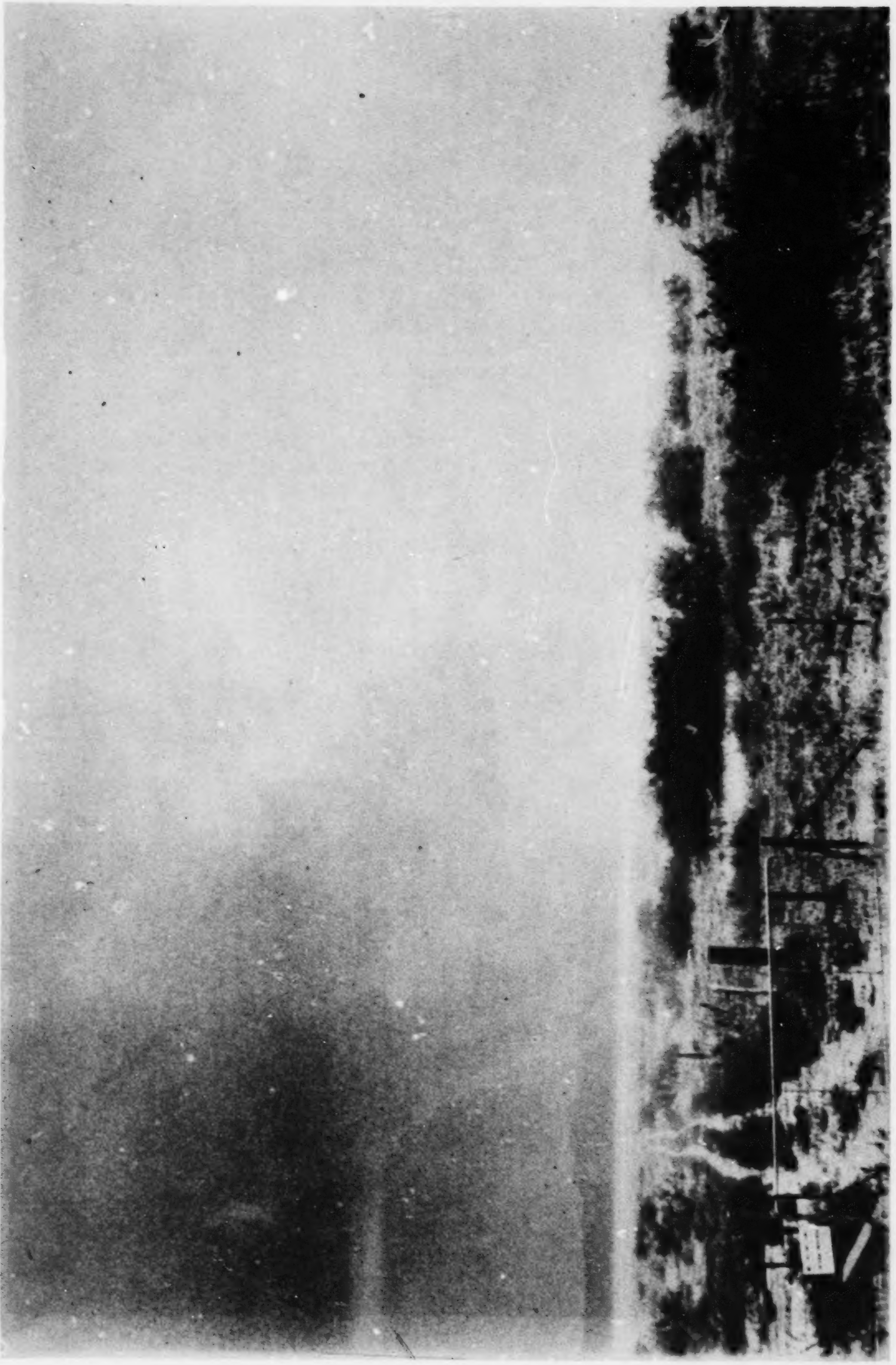
ESSENTIAL ELEMENTS FOR GROWTH OF FOREST TREES

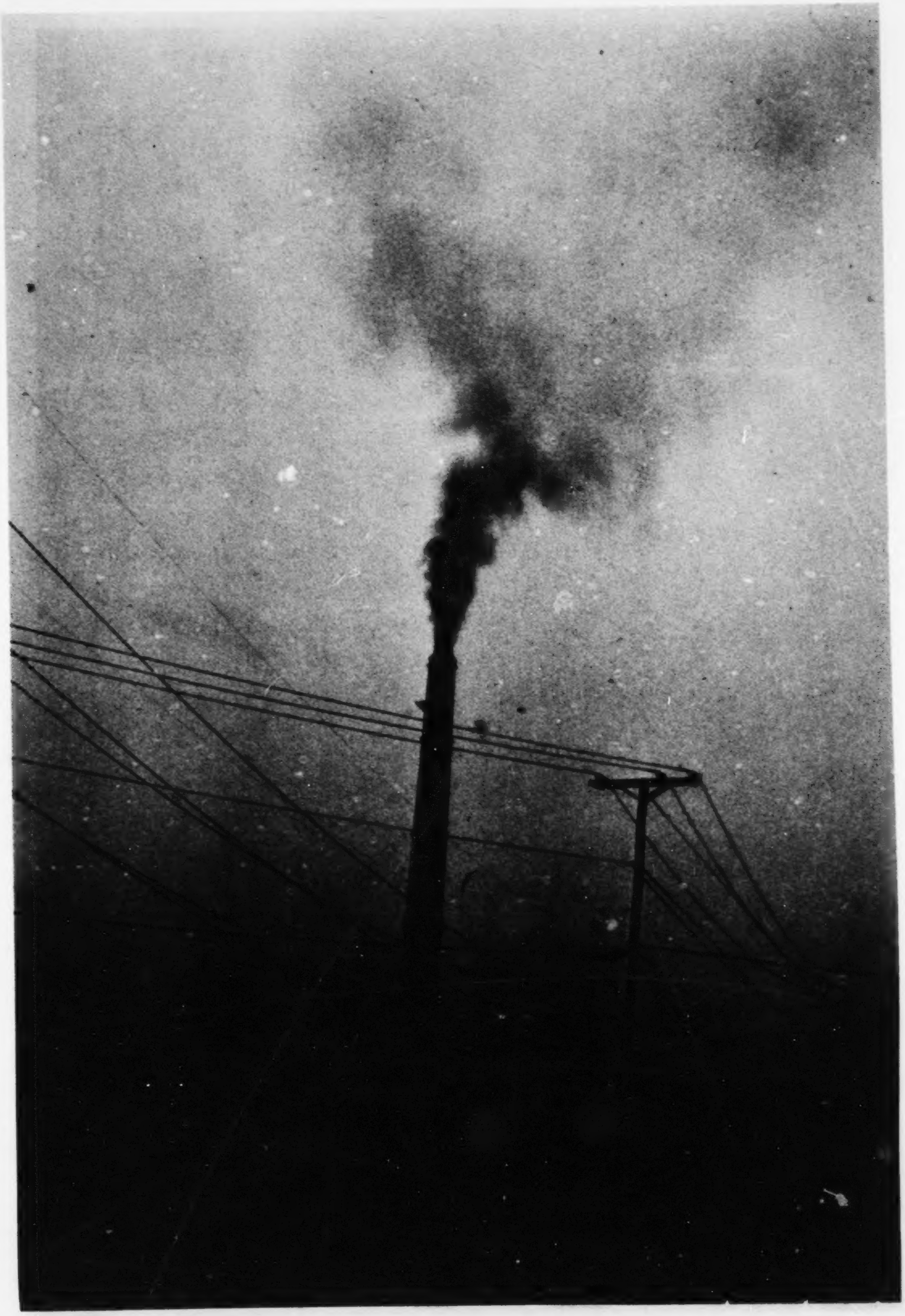
Elements	Distribution	Availability
Carbon	All organic compounds	Rarely limiting
Hydrogen	esp. cellulose, hemi-	" "
Oxygen	celluloses and lignin	" "
Nitrogen	Proteins, nucleic acids peptides, amino acids	Usually "
Phosphorous	Nucleic acids, phospholipids, ATP	Often "
Potassium	(?) Growing portions	" "
Sulfur	Proteins	Sometimes "
Ca, Mg	Pectic substances, chlorophyll	Rarely "
Fe, Cu, Zn Mn, Mo, Bo	Co-factors or constituents of enzymes or cytochromes	" "

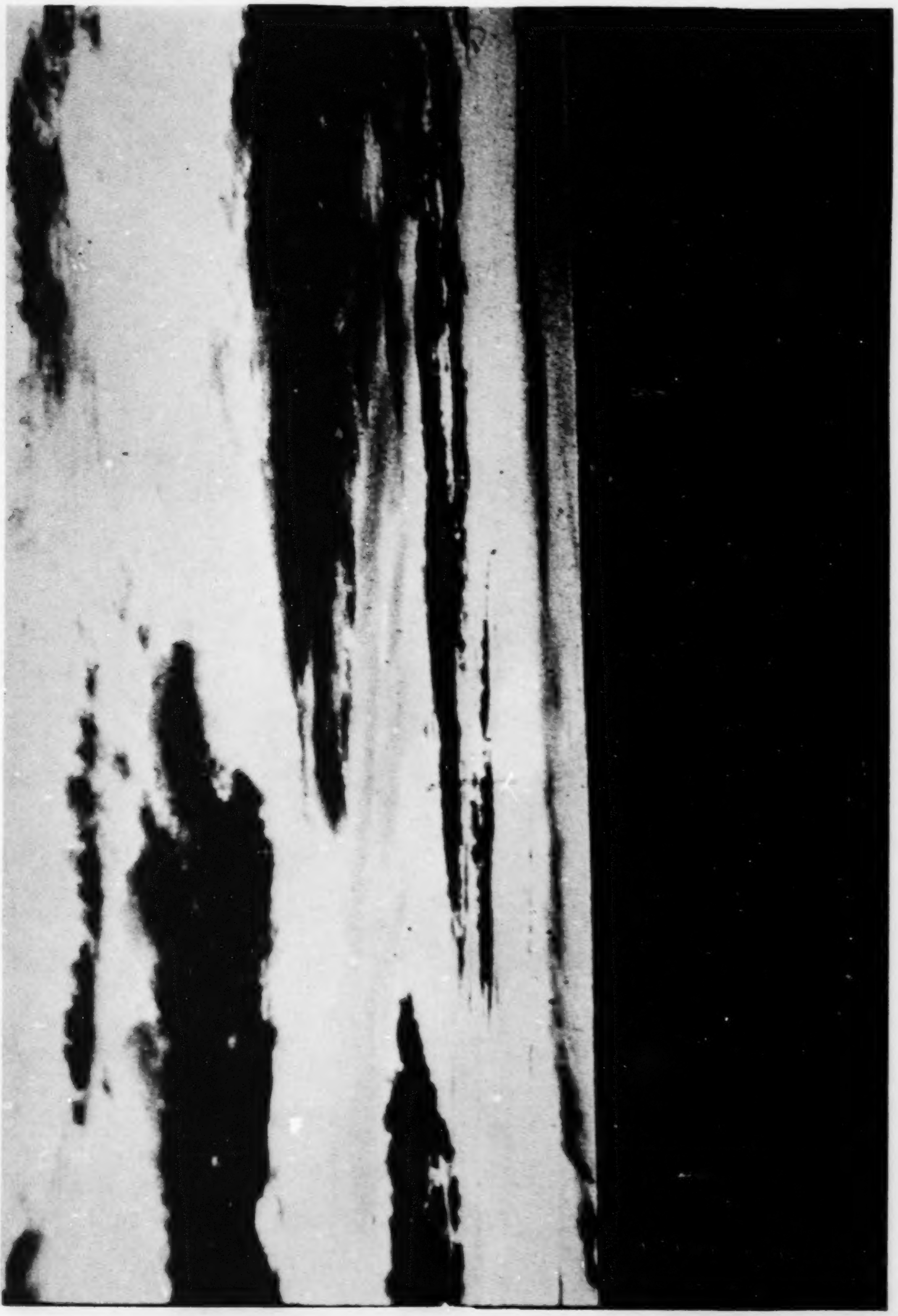


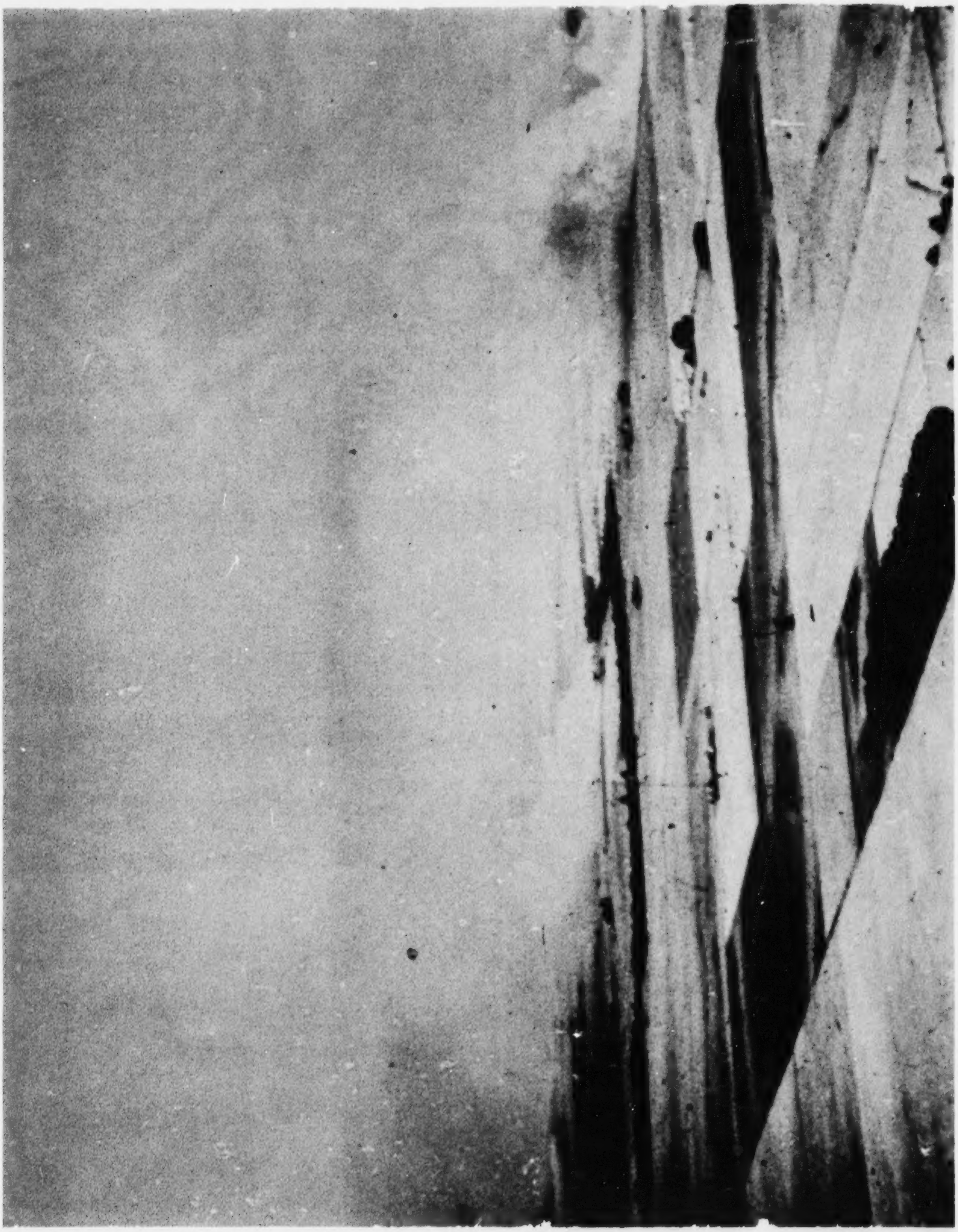
3. THE WEIGHTED ANNUAL AVERAGE OF NO_3 CONCENTRATION IN BUL
'ITATION AT ITHACA, N.Y. AS A FUNCTION OF TIME.

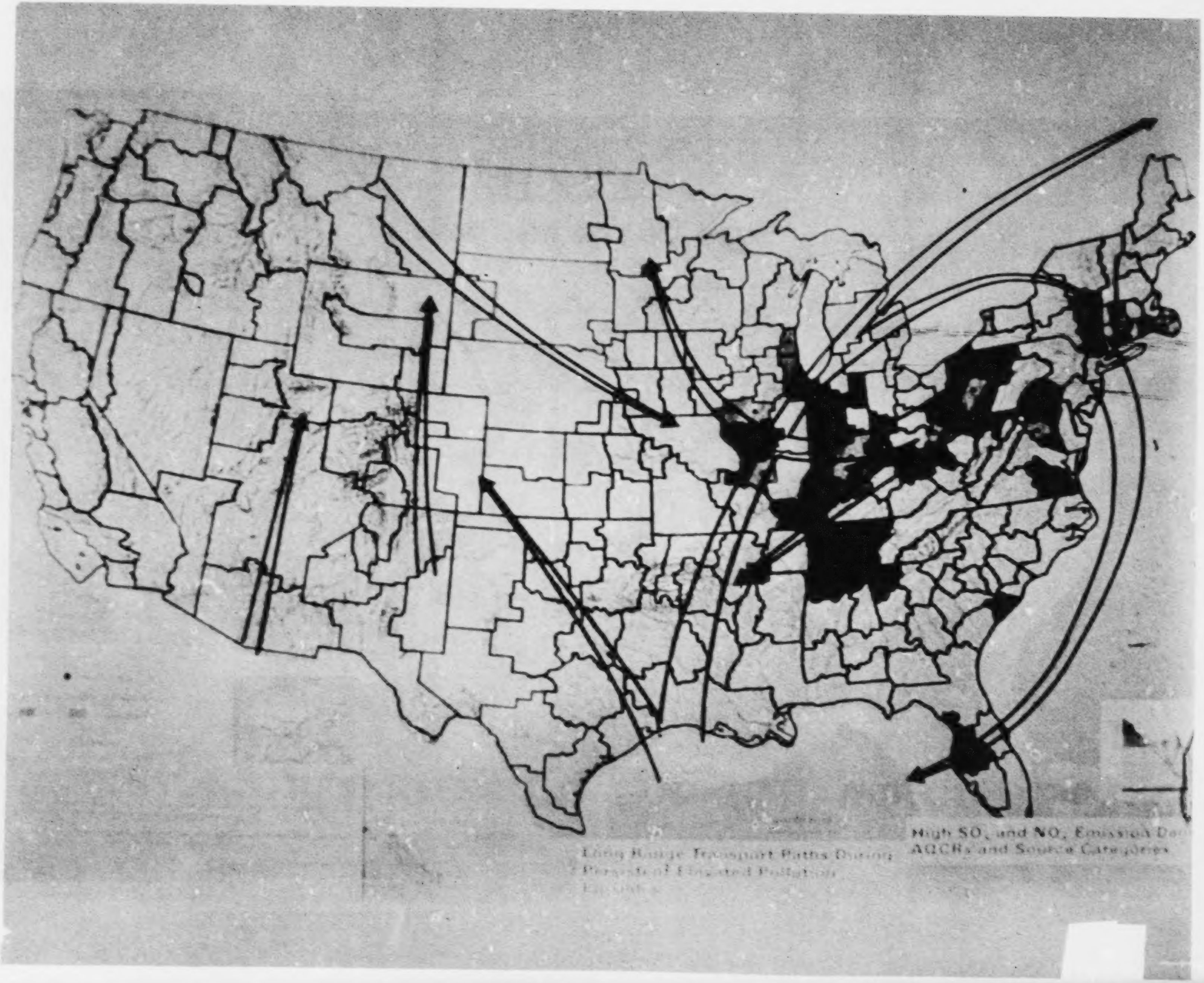
PLANTS HAVE "A TWO-FOLD KIND OF ROOTS, ONE THAT BRANCHES AND SPREADS INTO THE EARTH, AND ANOTHER THAT SPREADS AND SHOOTS INTO THE AIR, BOTH KINDS OF ROOTS SERVE TO RECEIVE AND CARRY THEIR PROPER NOURISHMENT TO THE BODY OF THE PLANT." Robert Hooke, 1671.










Long Range Transport Paths During
Periods of Elevated Pollution
Episodes
High SO, and NO, Emission Den
AQCRs and Source Categories

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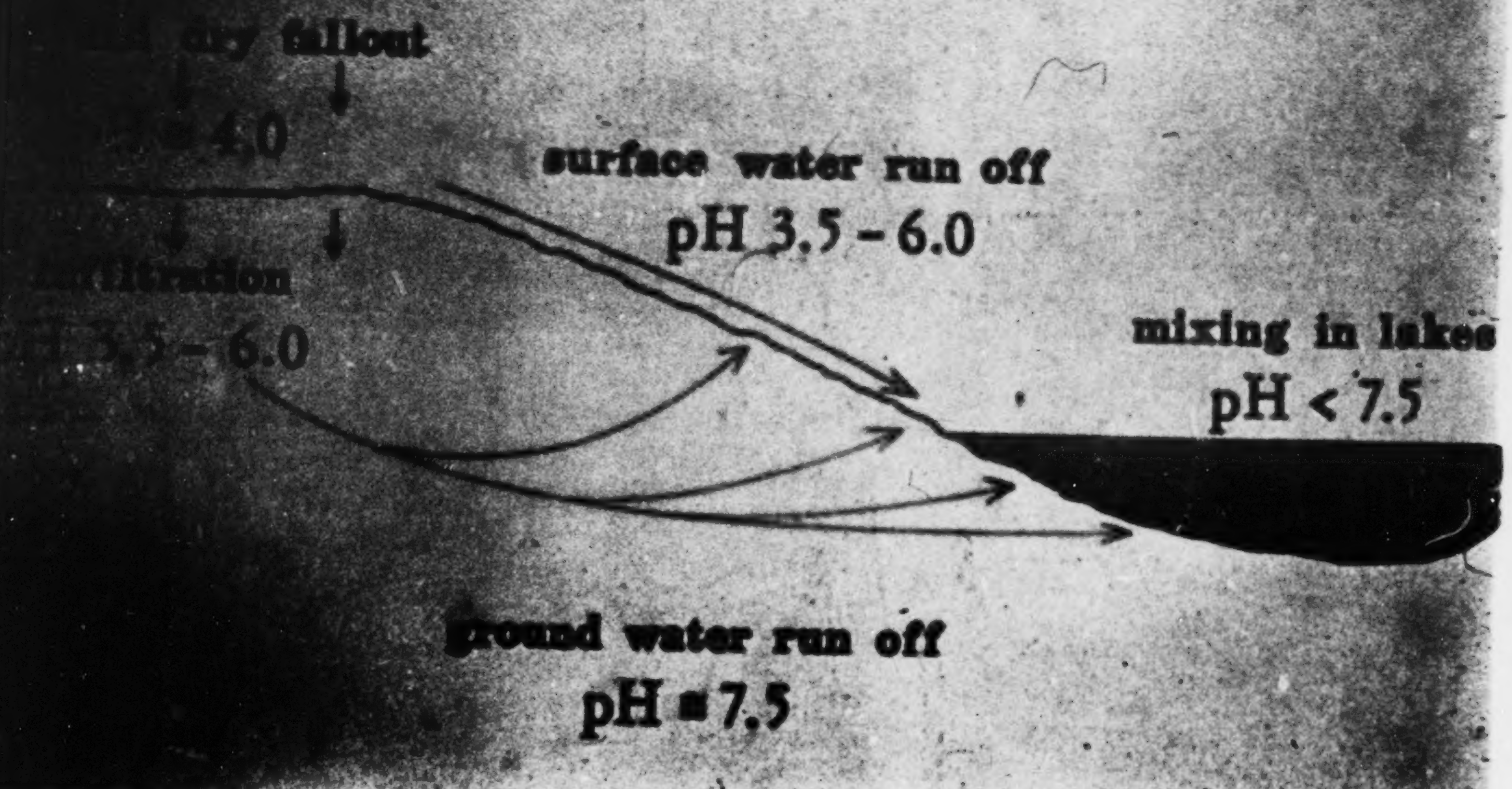
precipitation and the soil water reservo



dry fallout

4.0

surface water run off

pH 3.5 – 6.0

filtration

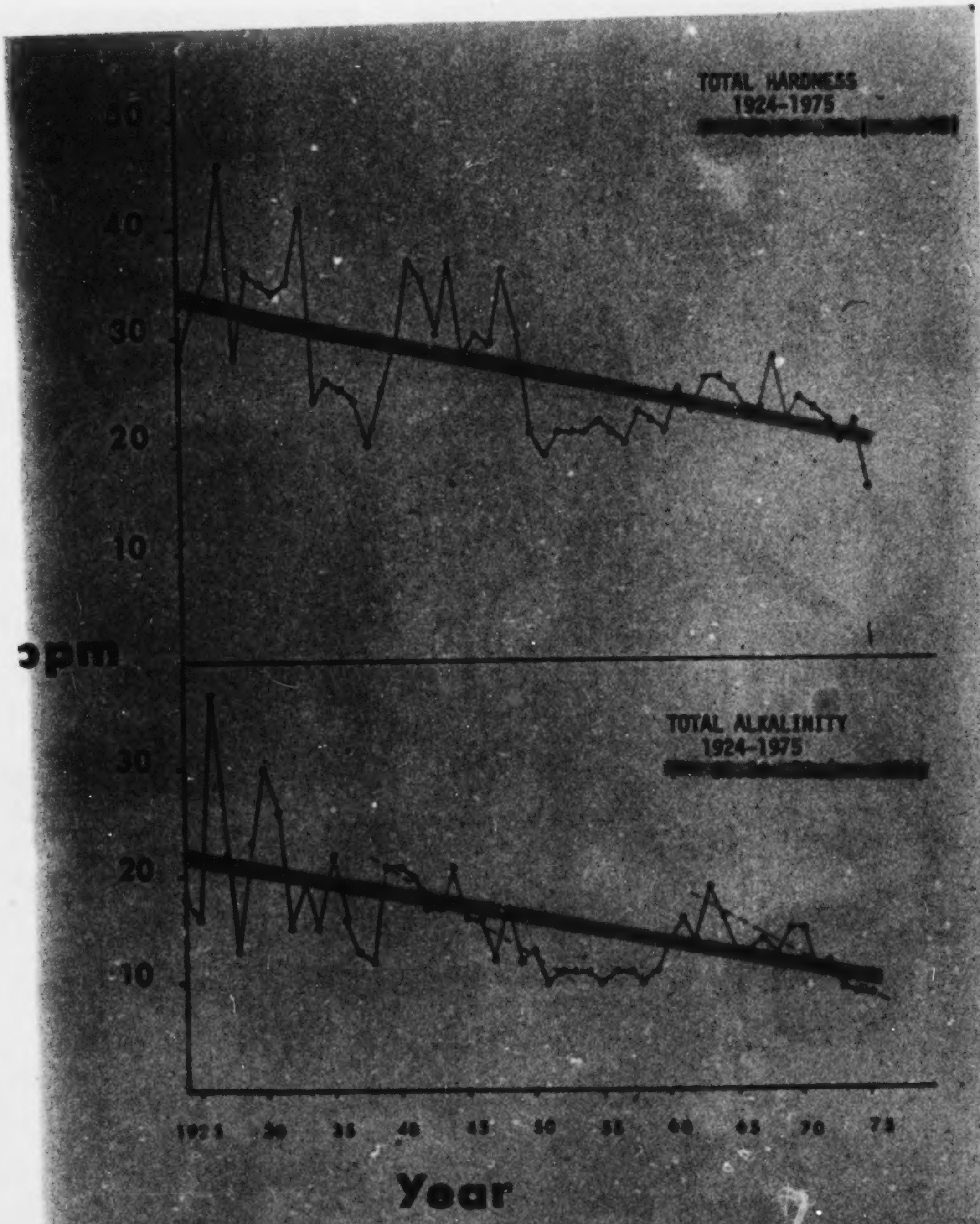
3.5 – 6.0

mixing in lakes

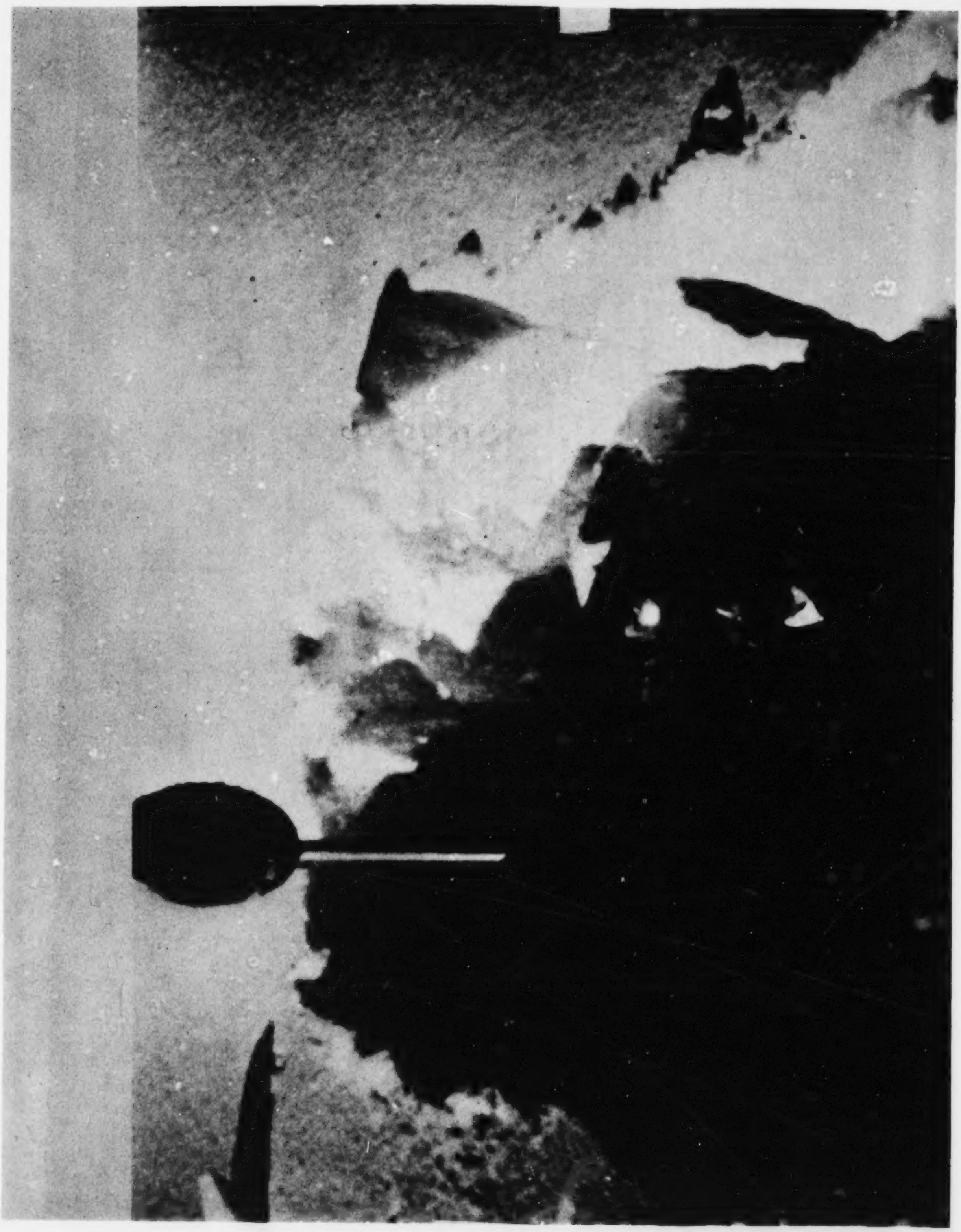
pH < 7.5

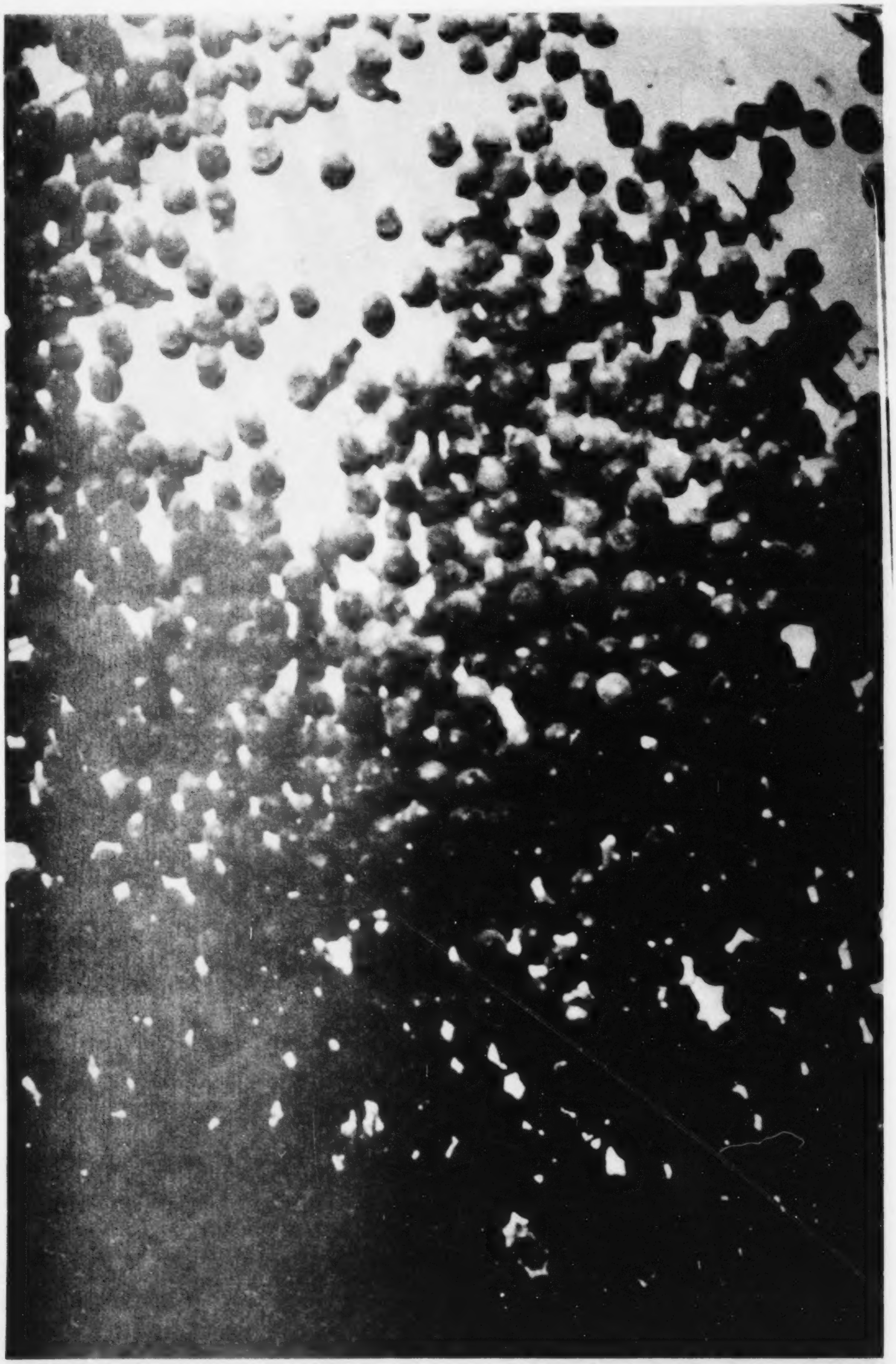
ground water run off

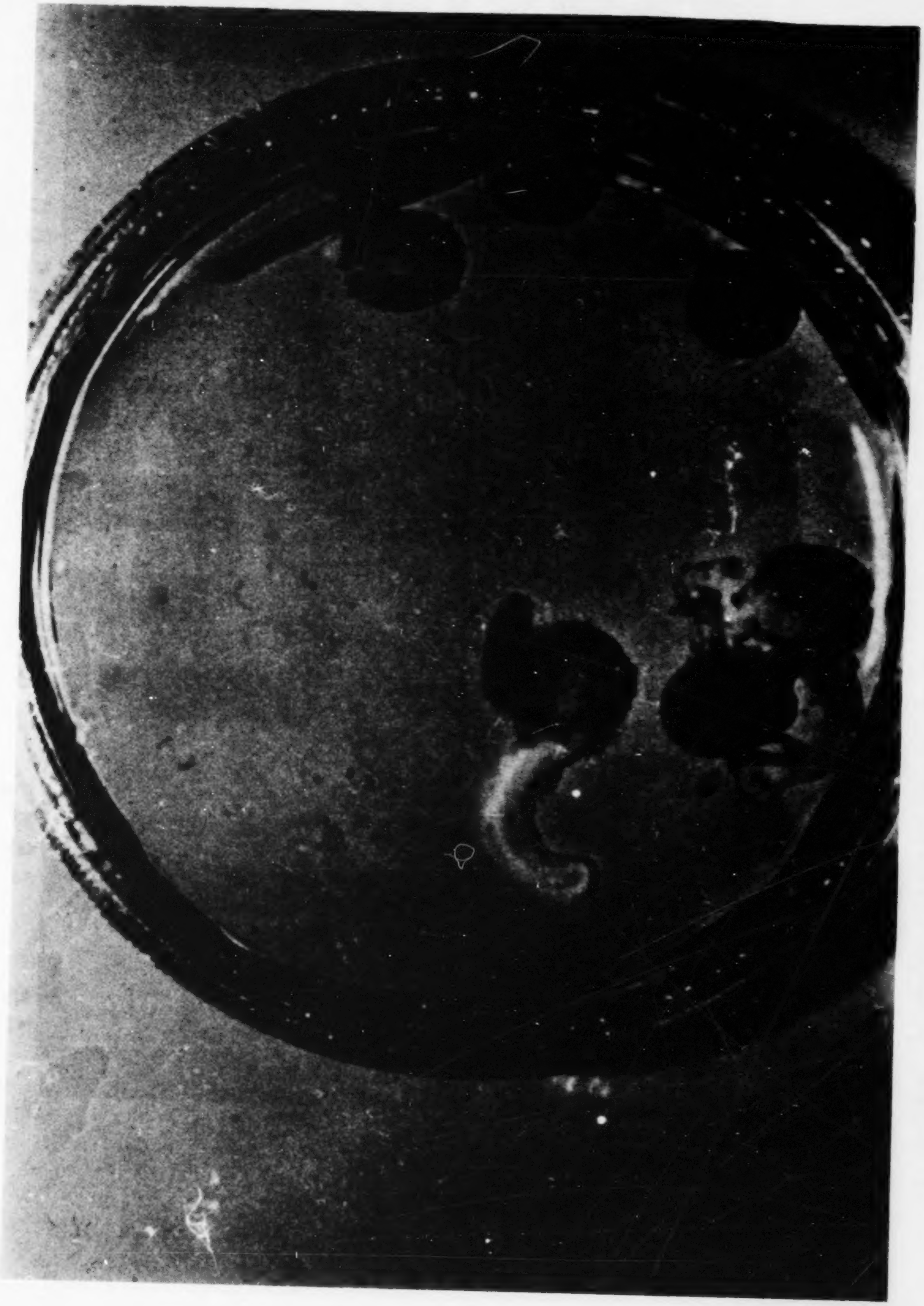
pH ≈ 7.5



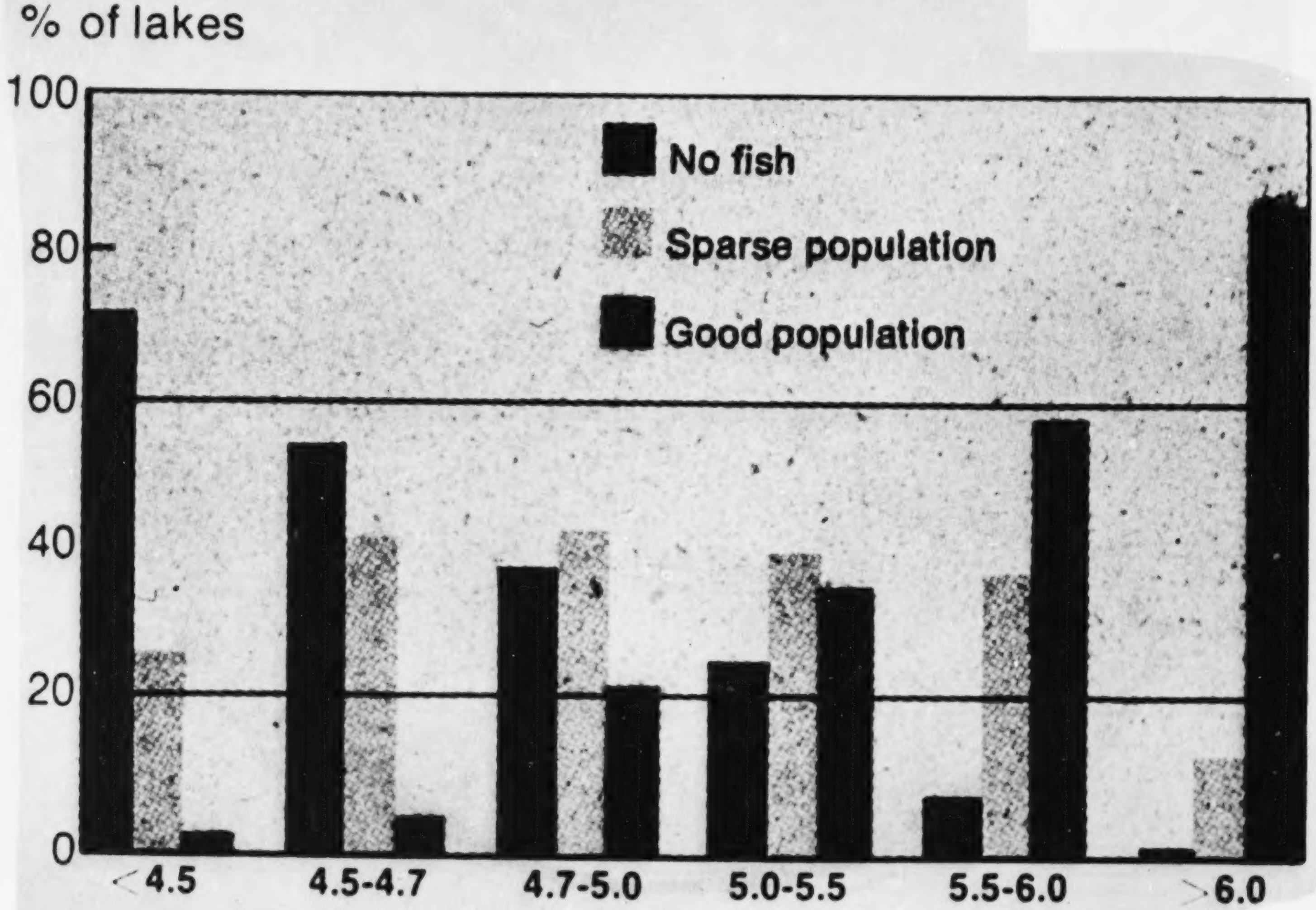
Average annual total alkalinity and hardness in Hinckley Reservoir, New York. (Annual means are based on daily measurements from 1924-28 and weekly samples from 1929-75.)

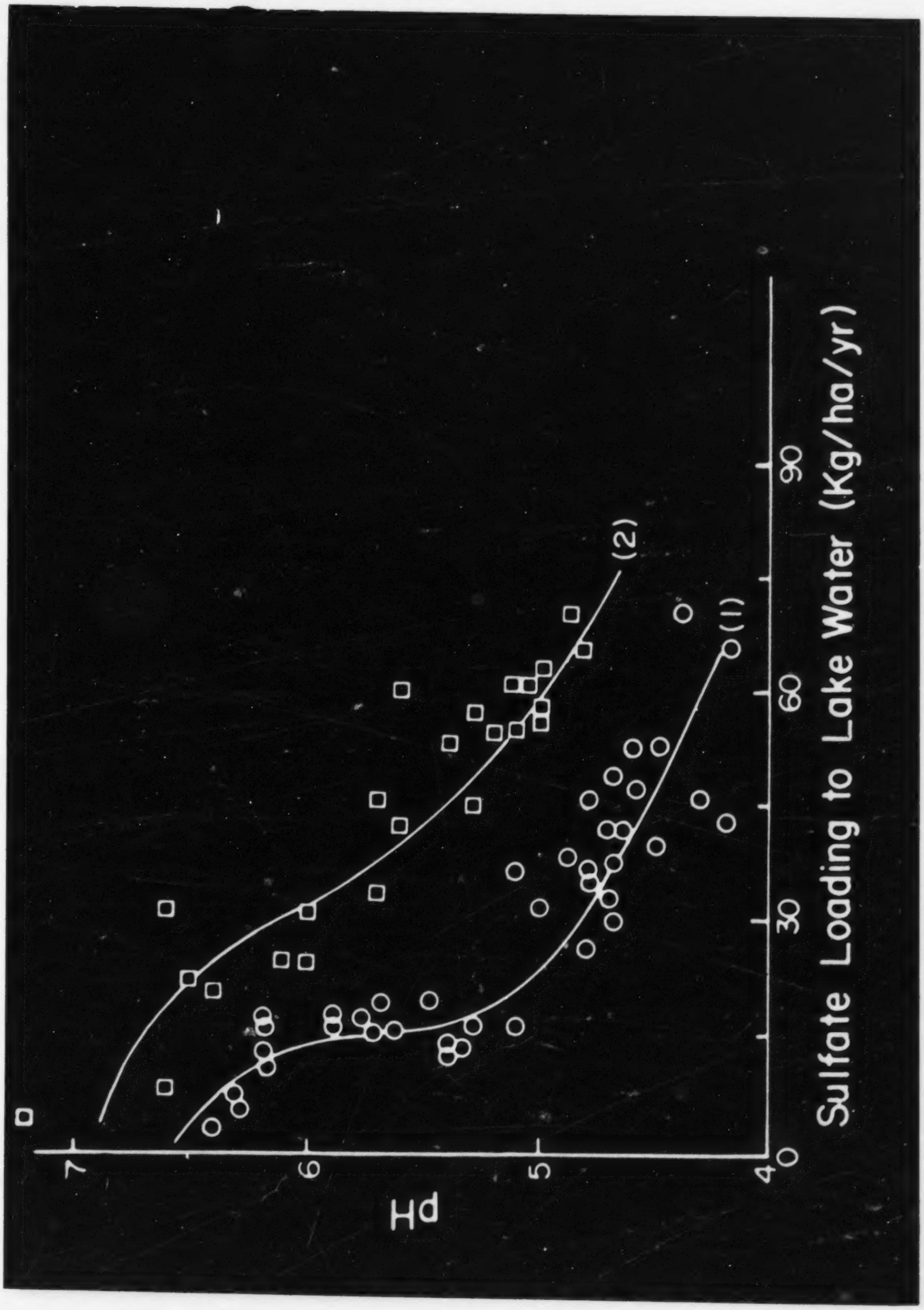






Fish population declines as the acidity of lake water increases




pH
7
6
5
4
0
30
60
90
Sulfate Loading to Lake Water (Kg/ha/yr)
(1)
(2)

POSSIBLE EFFECTS OF ACID RAIN ON VEGETATION

1) LEACHING OF MINERAL ELEMENTS FROM FOLIAR ORGANS.
2) LEACHING OF ORGANIC COMPOUNDS FROM FOLIAR ORGANS.
3) EROSION OF CUTICULAR AND EPICUTICULAR WAXES FROM PLANT SURFACES WITH ATTENDANT INCREASE IN VULNERABILITY TO PLANT PATHOGENS AND TO EXCESSIVE CUTICULAR TRANSPIRATION.
4) INTERFERENCE WITH NORMAL GUARD-CELL FUNCTION AND THUS WITH GAS-EXCHANGE REACTIONS OF PLANTS.

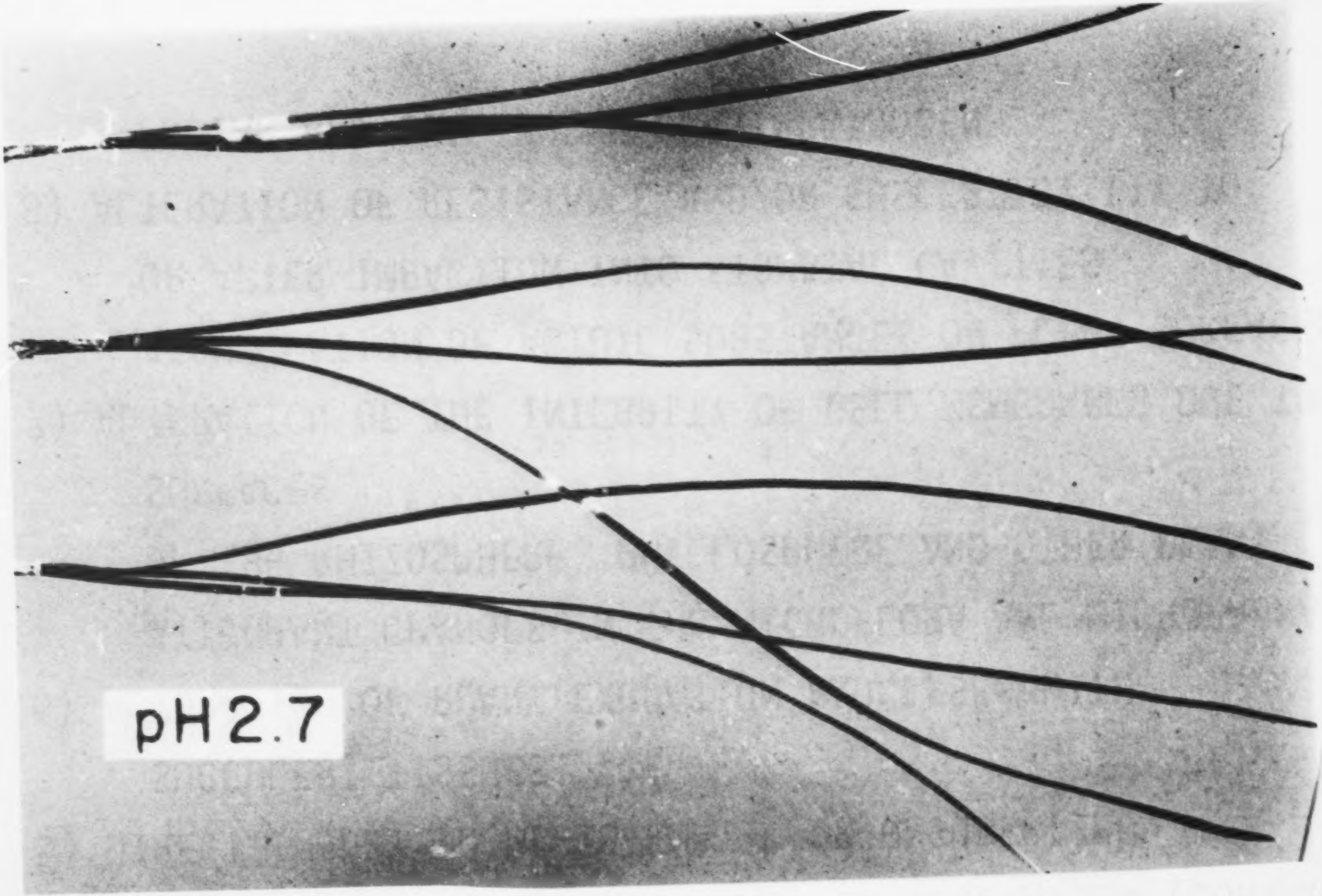
POSSIBLE EFFECTS OF ACID RAIN ON VEGETATION (Cont'd)

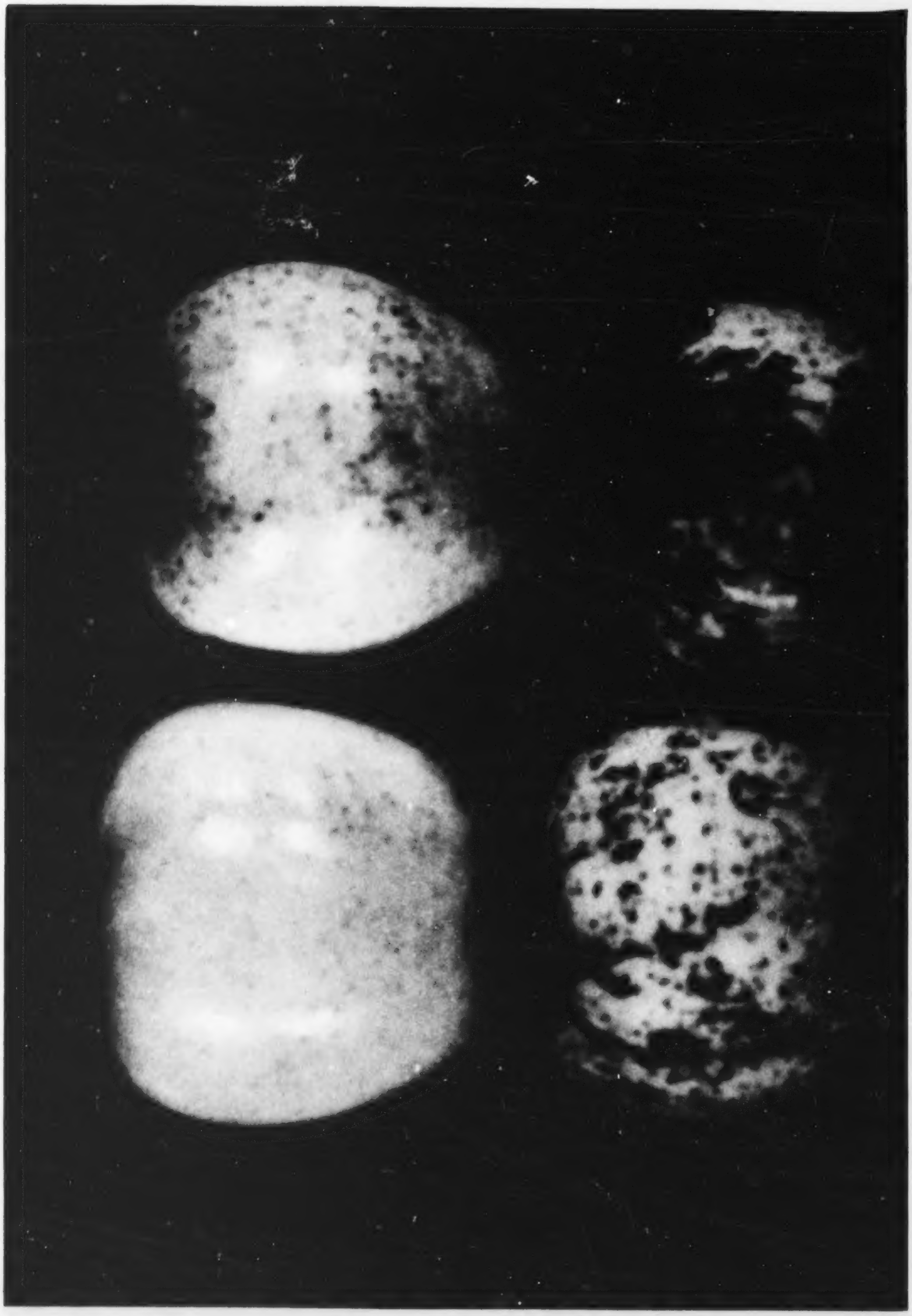
5) DIRECT INJURY TO MERISTEMATIC OR UNSUBERIZED SUCCULENT TISSUES.

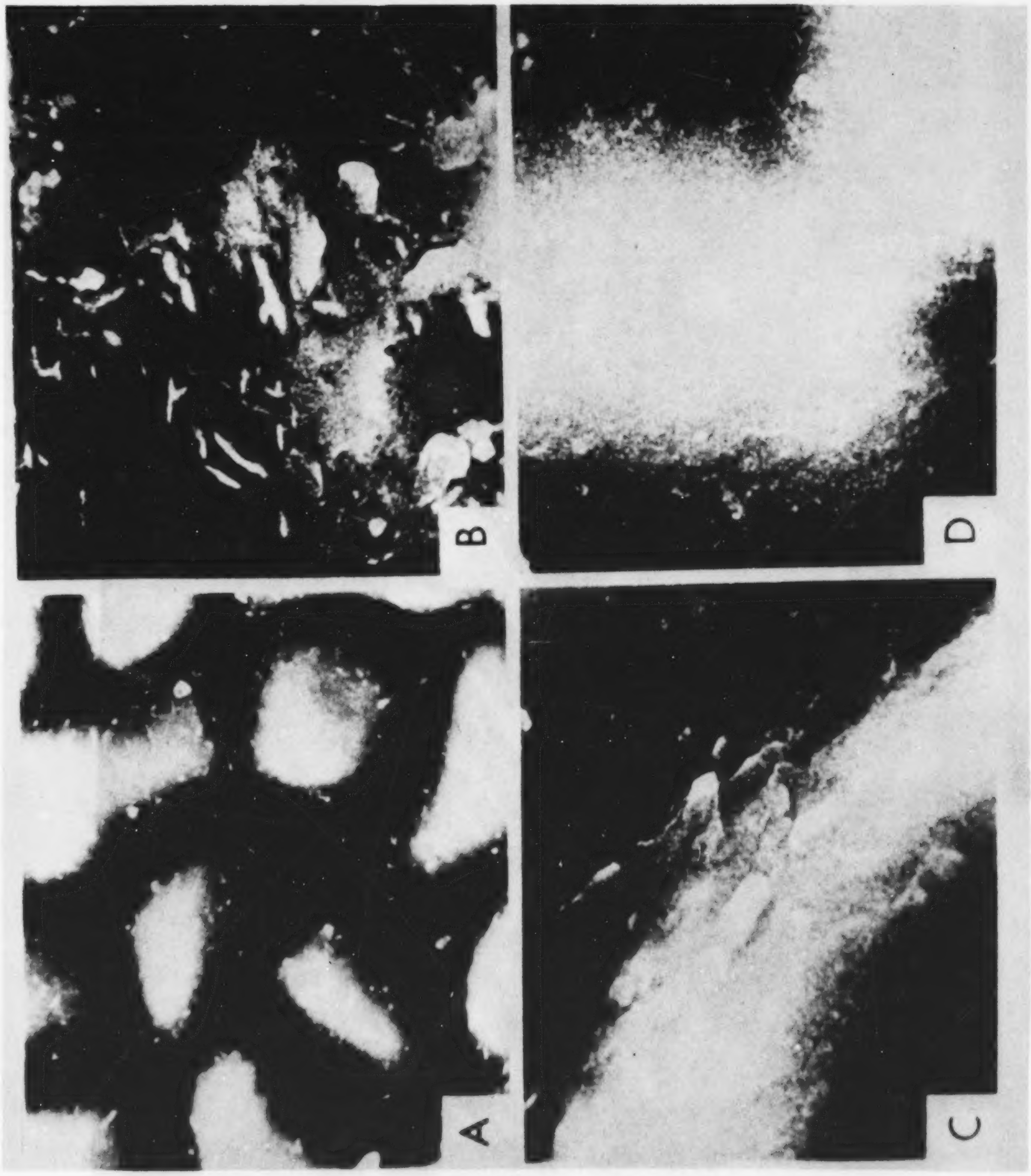
6) ALTERATION OF PLANT EXUDATION PROCESSES WITH ATTENDANT CHANGES IN THE MICROFLORA AND MICROFAUNA OF THE RHIZOSPHERE, PHYLLOSPHERE AND OTHER PLANT SURFACES.

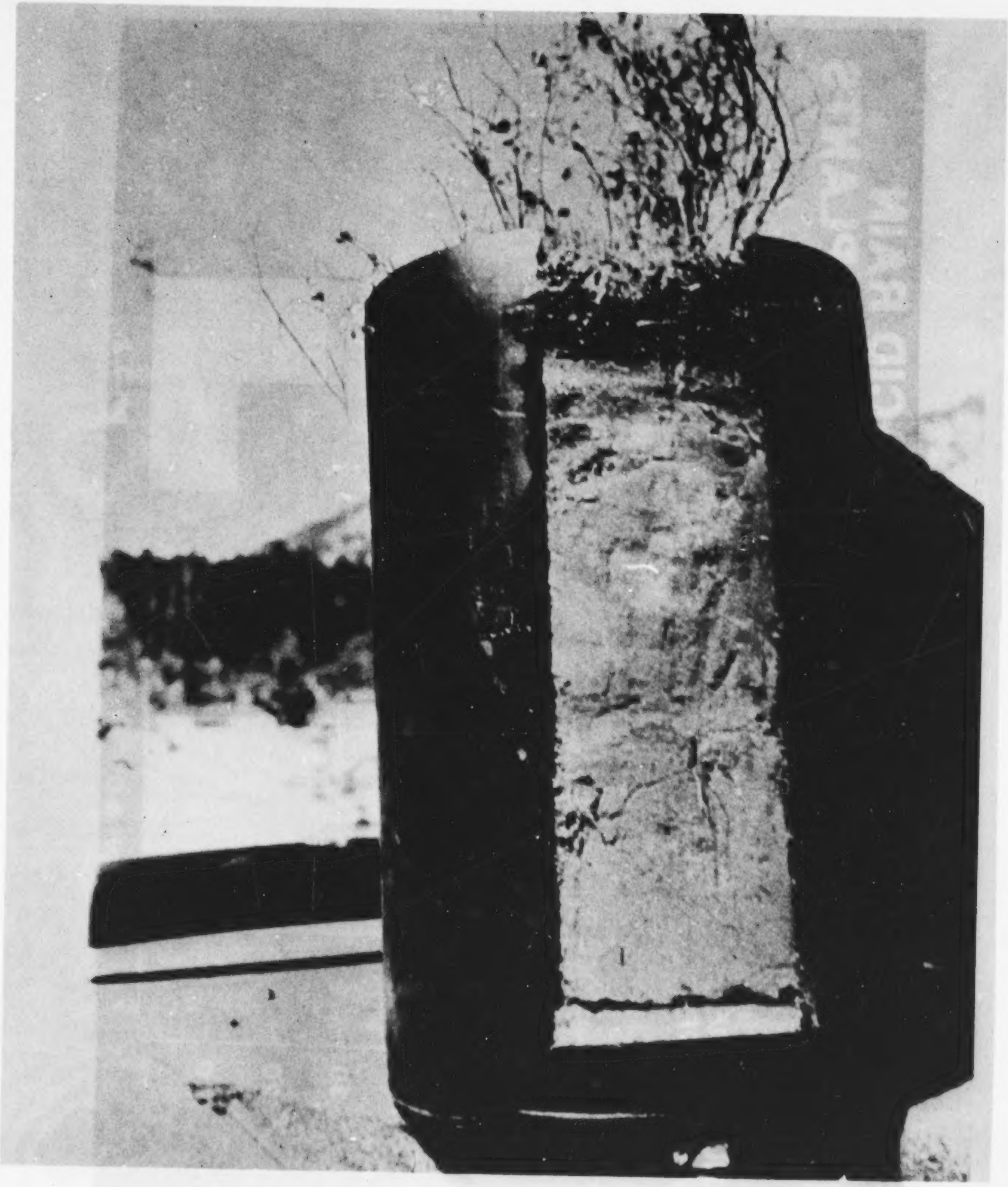
7) ALTERATION OF THE INTEGRITY OF CELL MEMBRANES DUE TO ACCUMULATION OF ACIDIC SUBSTANCES ON PLANT SURFACES OR AFTER IMPACTION INTO STOMATAL CAVITIES.

8) ALTERATION OF RESISTANCE AND/OR SUSCEPTIBILITY TO FOLIAR AND SOIL-BORNE PLANT PATHOGENS.

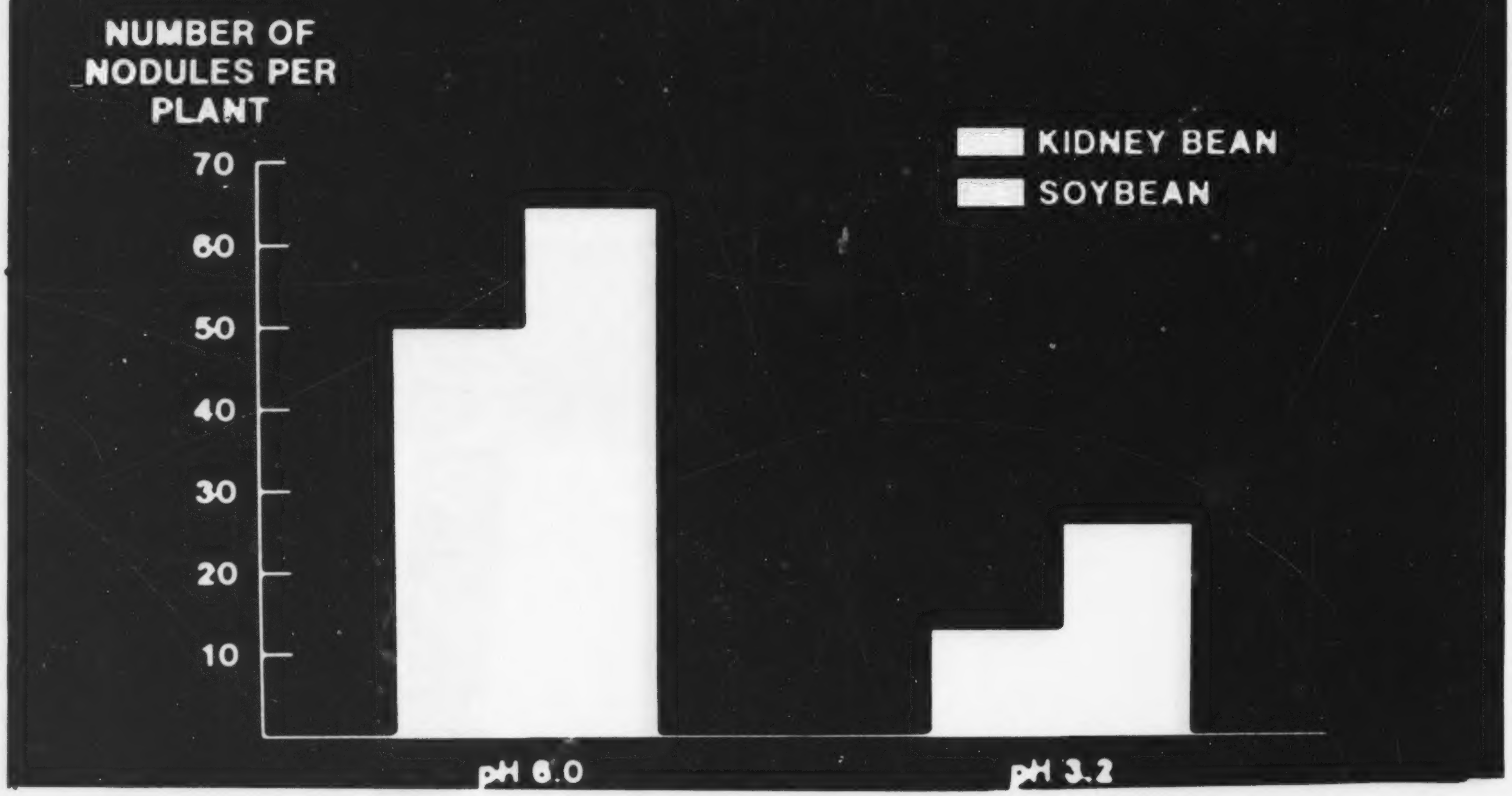

pH2.7

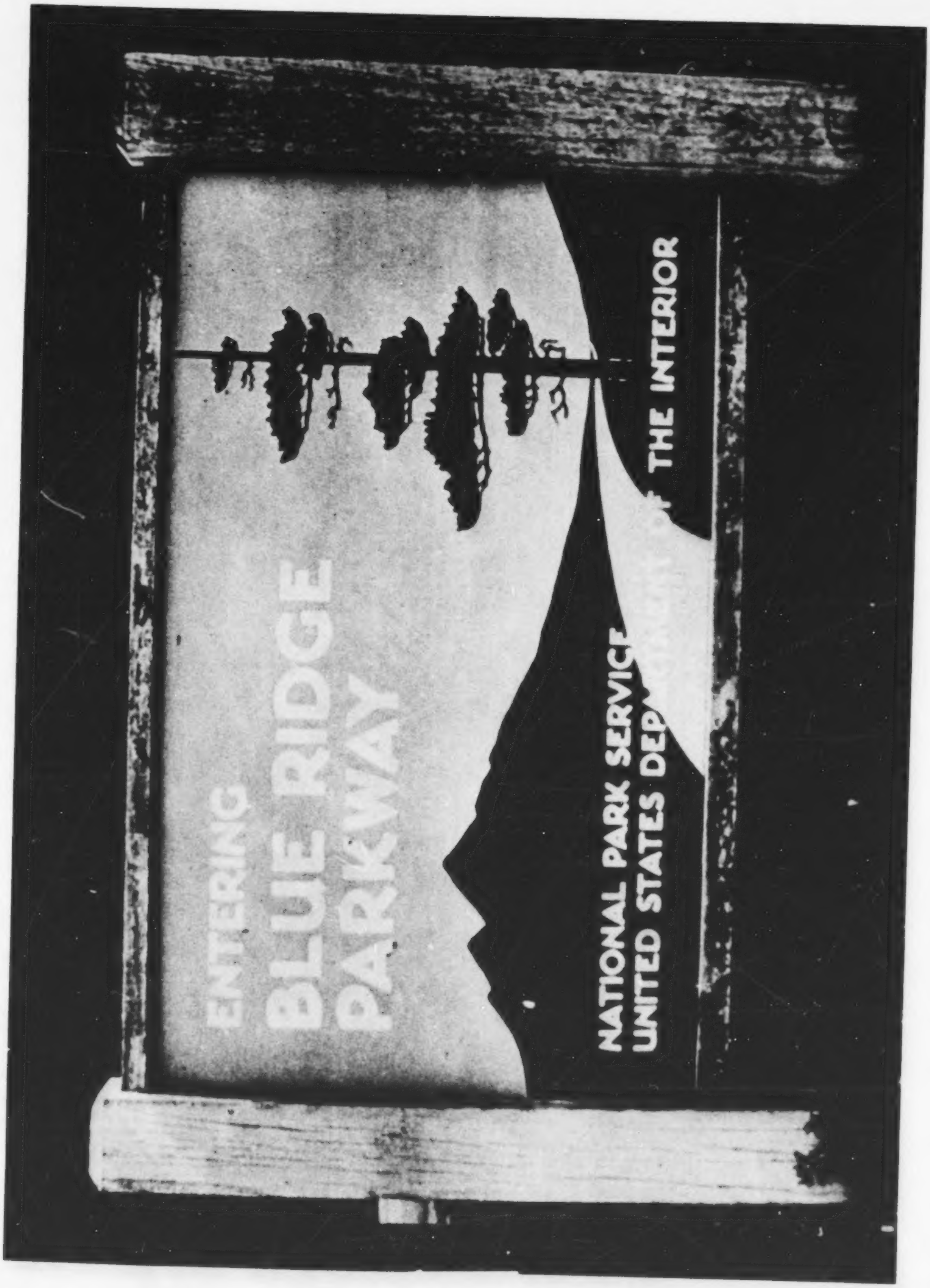



A
B
C
D



EFFECTS OF SIMULATED ACID RAIN ON ROOT NODULES OF LEGUMINOUS PLANTS




ENTERING
BLUE RIDGE
PARKWAY
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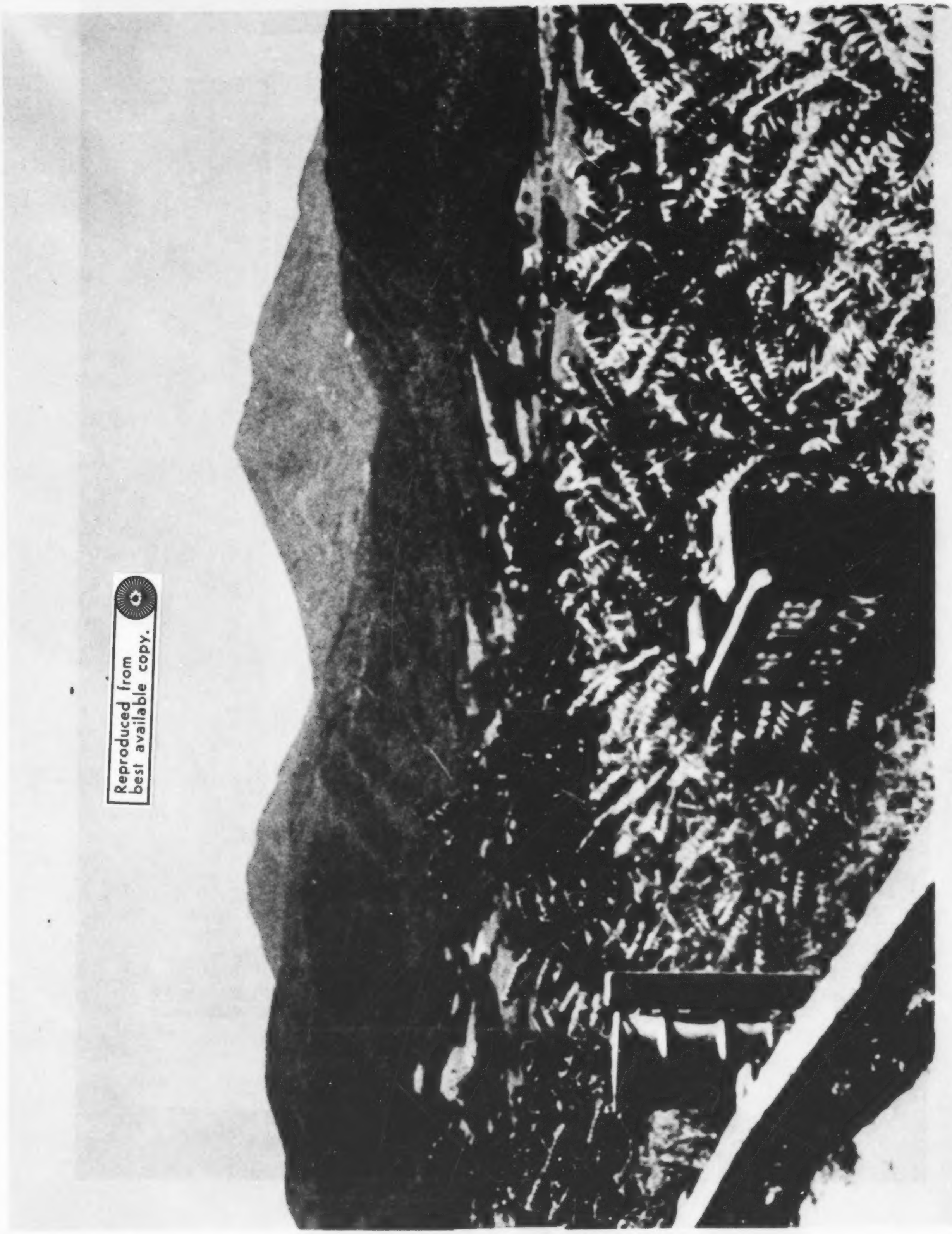

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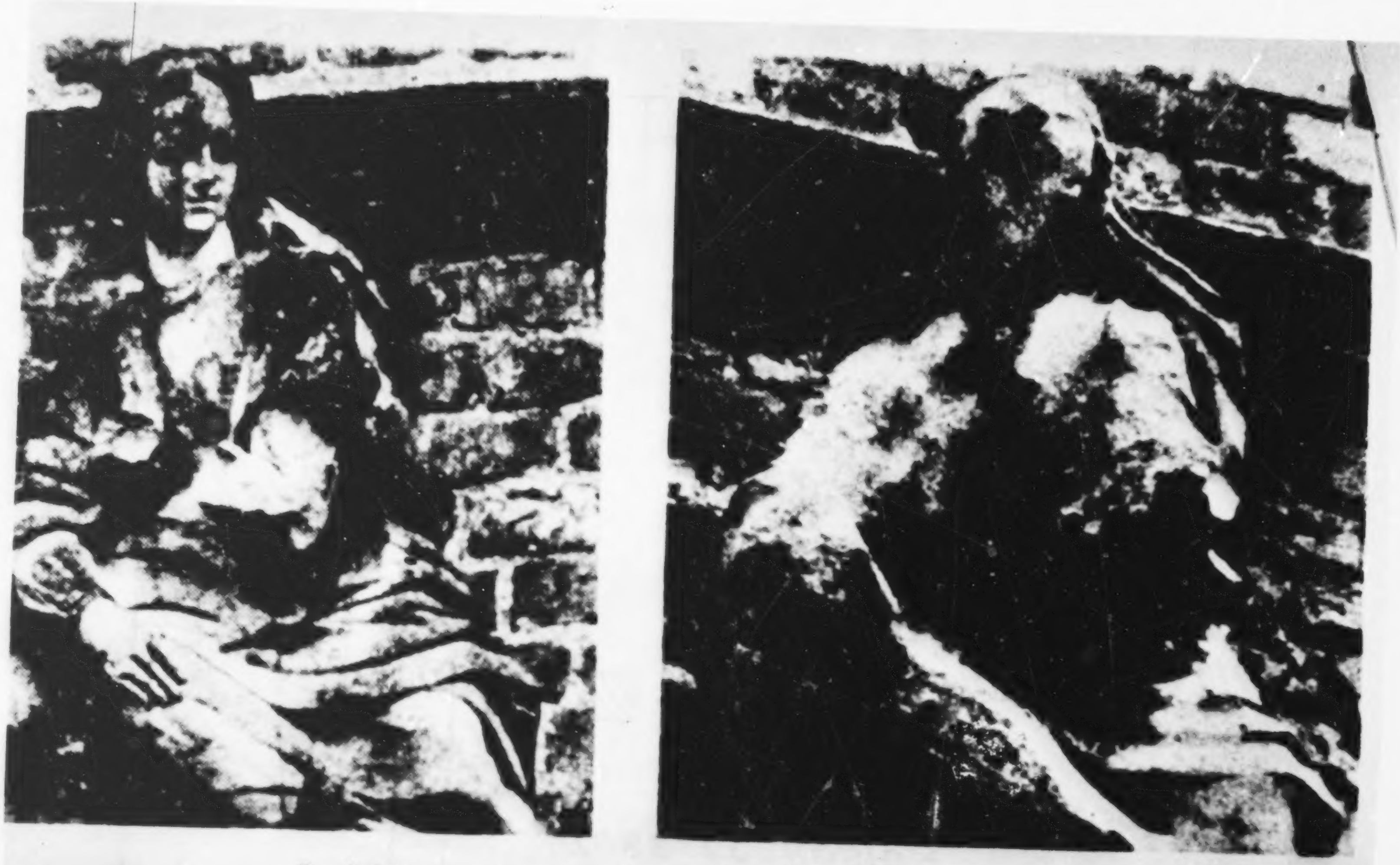
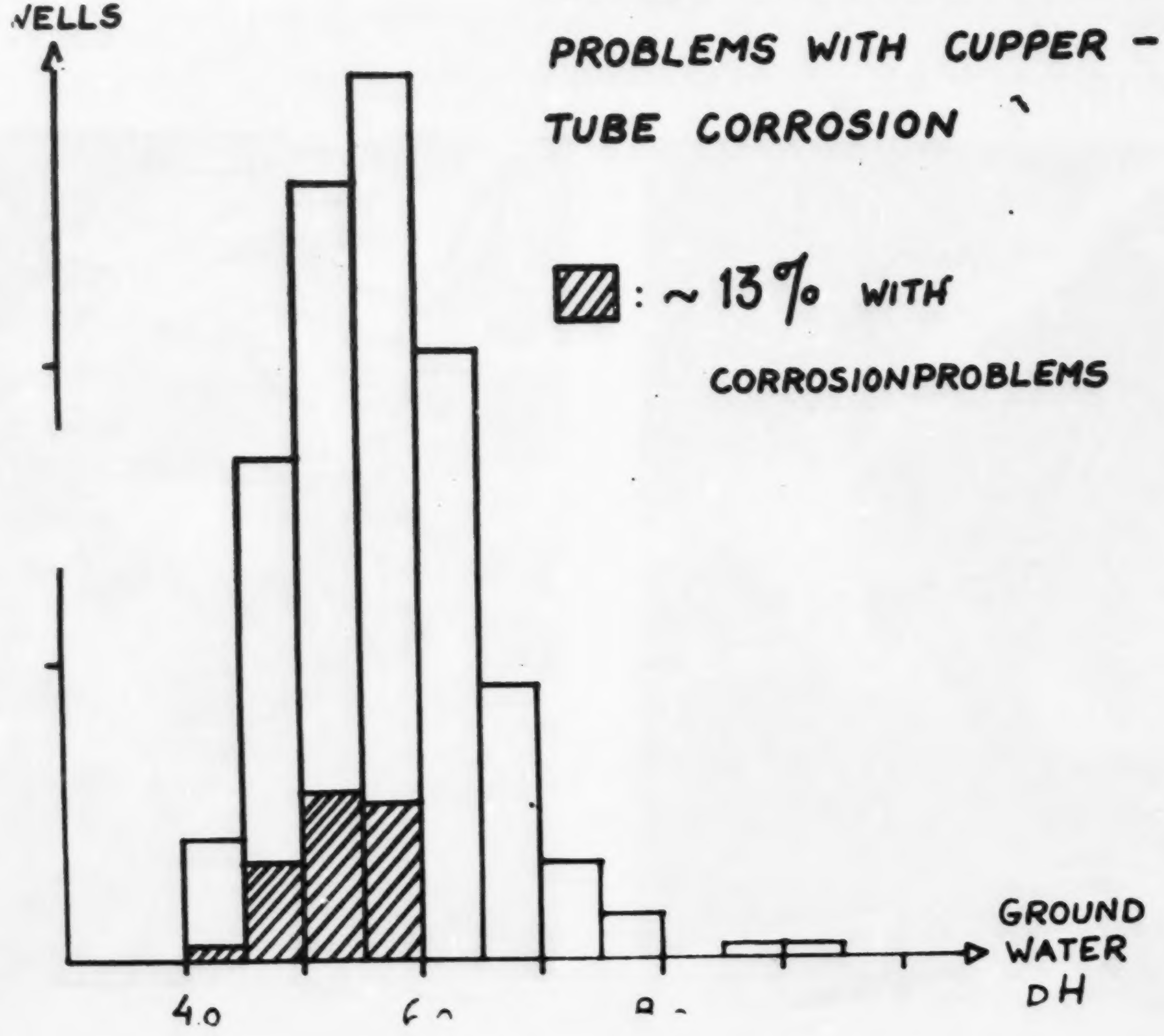


Luftföroreningarnas verkningar: En madonnafigur från 1702, fotograferad 1908 (t.v.) och 1969! (Ur "Der Spiegel")


NUMBER OF OWNERS CLAIMING PROBLEMS WITH CUPPER - TUBE CORROSION

ENVIRONMENTAL EFFECTS

ACIDIFICATION OF LAKES, RIVERS AND GROUNDWATERS RESULTING IN DAMAGE TO FISH AND OTHER COMPONENTS OF AQUATIC ECOSYSTEMS

ACIDIFICATION AND RELEASE OF METALS FROM SOILS

POSSIBLE REDUCTIONS IN FOREST PRODUCTIVITY

POSSIBLE DAMAGE TO AGRICULTURAL CROPS

DETERIORATION OF MAN-MADE MATERIALS SUCH AS BUILDINGS, STATUARY, METAL STRUCTURES, AND PAINT

POSSIBLE CONTAMINATION OF DRINKING WATER SUPPLIES BY METALS BEING RELEASED FROM SOILS AND PIPELINES

OBJECTIVES

A) DETERMINE SPATIAL AND TEMPORAL TRENDS IN THE SUPPLY OF BENEFICIAL NUTRIENT ELEMENTS AND INJURIOUS SUBSTANCES IN PRECIPITATION AND DRY PARTICULATE MATTER DEPOSITED IN VARIOUS REGIONS OF THE UNITED STATES.

B) ENCOURAGE AND COORDINATE RESEARCH ON THE EFFECTS OF ATMOSPHERIC DEPOSITION ON CROPS, FORESTS, RANGELANDS, SURFACE WATERS, DOMESTIC ANIMALS, WILDLIFE, FISH, AND MATERIALS.

Dr. Gage: Thank you, Ellis. The third speaker this afternoon is our distinguished colleague from Canada, Mr. Ray Robinson. He is the Assistant Deputy Minister of the Environmental Protection Service in Environment Canada. On the U.S. side, it takes both Dave Hawkins and myself to fill Ray's shoes. He is in charge of both the research and the regulations for this problem in Canada. We have also enjoyed working with Ray as the delegate from Canada for the bilateral discussions on the acid rain problem that we both share. I would like to turn the podium over next to Ray.

Mr. Robinson: Thank you very much Mr. Chairman. It certainly is a great pleasure to be here. I would like to begin by expressing appreciation on behalf of my government for your courtesy in inviting a Canadian to make a presentation here today. Such courtesy says something about our relations and that something is good. Much of what I am going to say will necessarily sound similar to what has been said by previous speakers. That's a simple consequence of geography which dictates that we share the problem of acid precipitation.

History has demonstrated that we have successfully cooperated to resolve similar problems in the past. The Canada-U.S. agreement on Great Lakes water quality is one example of the success story that is unfolding. In the early 1970s we found ourselves in a situation similar to that presented by acid rain. We did not have all the scientific knowledge which we would have liked, but we did have enough to know that we had a worsening situation and that both countries needed to initiate or extend control action. As a result of those actions, we are now seeing the environmental systems on their way to recovery.

It has been said that there are many uncertainties concerning the phenomenon of acid precipitation and we have had some discussion of that already today. There is no question that these uncertainties do continue to exist. We are joining our colleagues in the United States and in other countries in working to fill some of the gaps in knowledge that have been identified. It is also true that a great deal of research has already been done. Again, without repeating what has already been said, we see quite clearly that there are a number of conclusions that have been brought out and which we can use as a base for guiding us in terms of the decisions we should make.

Rather than go through my address in detail, which is, as I say, so repetitious of what you have already heard, I will pick out points here and there that add a Canadian flavor, if you will, to some of the points made. My text will, in fact, be made available to everybody so you can look at the detail later if you wish.

Our own monitoring, for example, has certainly reinforced that which you saw presented earlier--the trend in acidity of rain over the past two decades. There has been a marked increase in acidity. There has been no question of that whatever. Similarly, in terms of documenting the deterioration of watersheds, we again have quite good data going back a number of years which demonstrate progressive deterioration. For example, in the case of the Cloche Mountain Lakes in Ontario, we have done some very detailed work demonstrating the impact of lake acidification on fish populations. It does affect different types of fish at different levels. From this and other studies we can certainly conclude that lakes in sensitive areas, some hundreds of miles from the source, show a marked drop in the number of fish species when the acidity of water moves above a certain point.

Similarly, our own examination of impact on our streams show results very much in tune with those established earlier in Norway, especially the impact of the so called pH shock in the Spring, both on the actual living fish and particularly on their capacity to spawn.

I would say further in the matter of property damage, that we do not have a good data base at this time. We did in fact undertake a study by our National Research Council. The study was completed about 7 years ago but the data was about 10 years old. At that time they came up with some conclusions and came out with some figures. The figures seemed extraordinarily small by today's standards, about a couple of hundred million dollars a year. I rather think that if we add both inflation and the increase in acidity over the 10 years in between, that figure would skyrocket. We are in the process of updating those figures to get a clearer understanding of the economic impact of acid rain on property and on buildings.

Similarly, and it hasn't been mentioned today or very little, we do not have conclusive evidence in the area of human health. Here we are referring not so much to the indirect effects from the release of heavy metals, which have been referred to, but the other problem of the inhalation of fine particulates. We are aware of the conclusions that were drawn by the OECD in this area, we are aware of the work of your Brookhaven National Laboratory, and of Drs. Mendelson and Olme. We are increasing our efforts to look into this area but we are very conscious of the fact that there is still much controversy and much doubt about it. I think I could say this, that one of the things that is particularly troubling about the concerns relating to health and to property is that they can impact a very much wider segment of society simply because they are not dependent upon the recipient being particularly susceptible, except in the case of health. I am referring to areas which are geologically susceptible, which is one of the phenomena that mark the acid rain problem, particularly in Canada, as I will mention in a moment.

Some of the unanswered questions: well, we don't know why some of our lakes have acidified more quickly than others. We are not sure why some fish species are more sensitive than others. We don't know why toxic heavy metals seem to be released with increasing acidity at different rates. We also do not yet know how large an impact accumulative acidification will have on our generally thin soil cover, or on forest productivity, which was mentioned earlier and which, in our Northern latitudes is often marginal, I will say more about that in a moment. Research to answer these and other questions is going on and we have set up a mechanism between Canada and the U.S. to ensure that research is well coordinated between the two countries. We are, nonetheless, convinced of one thing. The inescapable relationship between the release of certain pollutants which are increasing the acidity of precipitation, and those effects that have so far been thoroughly documented obliges us to look for effective ways of taking early action to control those pollutants.

There are general reasons why this particular problem is of particular concern to Canadians and especially those who live in the Eastern half of our country. Large parts of Eastern Canada are underlain by rock types that are deficient in the minerals needed to effectively neutralize more than limited quantities of acid. Many of those same regions of Canada and particularly Northern Ontario and Quebec had most of their soil cover pushed south during the last ice age. For the most part, the thin post-glacial soils we find there now also have a very limited capability for absorbing and neutralizing acids. The Canadian climate compounds the problem, in that much acidity is stored in the snow over the winter and then released in a sudden burst in the spring. As mentioned earlier, this brief but often intense increase in acidity can be disastrous for the fish spawning and, indeed, for the living fish.

North American weather patterns dictate that the plumes from the stacks of major industries in the industrial heartland of both our countries very often move across parts of Eastern Canada. The generally warmer and more humid condition of air masses coming from the south and west accelerate the transformation of some of the pollutants to acid. We, thus, find ourselves in a situation where some of the most sensitive areas of Eastern Canada are frequently downwind from some of the major North American pollution sources. As more than half our population is to be found there, this demographic arithmetic adds a major social and economic dimension to Eastern Canada's vulnerability to acid rain.

The natural environment of Eastern Canada not only sustains a resource base for important components of the nation's economy but also constitutes an invaluable and irreplacable contribution to the nation's quality of life and its environmental heritage. Without measures to deal with acid rain and other elements of the class of problems associated with the long-range transport of air pollution, Canada's tourist, sport, and commercial fishing industries face substantial adverse economic impact in the years ahead.

The attention of the media has been drawn understandably and indeed properly to the impact of acid rain on our lakes and streams, particularly because such impact is extremely time sensitive, and in many respects irreversible, but also perhaps because tens, if not hundreds of thousands of lakes could ultimately be affected. However, those of us who are responsible for addressing the problem are becoming increasingly concerned about the less spectacular but no less real impact on soil chemistry, and, therefore, on vegetation growth. Our scientific work very much reinforces the conclusions that you have had put before you so far. What really is in doubt about the changes that we see occurring in soil chemistry, is the speed with which they are occurring. As noted above, we are uncertain about the precise effects these changes have on forest productivity which, to underline the point again, in our northern latitudes is often marginal.

The forest industry is our largest industry in Canada, and it competes on a world-wide market. We cannot afford anything which would reduce that competitiveness. I realize that must create something of a conflict of interest with some of the Southern States represented here, particularly since I just heard a few moments ago that sulfate and nitrate may be helping out our competitors to the South. I assure you, I am not accusing you of a great plot.

In undertaking the essential task of examining what we can do in Canada to address this problem, we are proceeding from three premises.

First, we are convinced that acid rain is a serious and worsening environmental problem. Second, policy decisions on resolving the problem will have to be made without the luxury of having all the scientific evidence we might like to have. Third, the solutions may well be expensive, and therefore, have a substantial social and economic impact. We are, therefore, accelerating the process of developing--in concert with the Provinces concerned and in consultation with major industry--control stategies that are appropriate to the Canandian situation.

Our control strategy program, now well underway, comprises four major components. The first is the assessment of the major sources of concern, and of the reduction of emissions which would accrue from the application of specific abatement technologies. The second is the examination and assessment of the economic and social consequences of achieving various levels of reductions in emission. In other words, what impact would such additional costs have? The third is a macroscale assessment of the physical and economic benefits which would be expected from reduced environmental damage, and the fourth, the development and analysis of abatement options which is really pulling together the first three.

Before an American audience, it is important that I explain that the distribution of sources in Canada of acid causing pollutants is very different than in the United States. Nearly 60% of our contribution to SO_2 emissions, in excess of two million tons per year in Eastern Canada comes from nonferrous smelters. Less than 15% comes from coal-fired thermal plants. (That's a very different situation than in the U.S.) The remainder is from a wide variety of industrial sources, mostly emitting at a low level.

I notice we have not said very much today about high stacks but, in fact, they are a factor in the problem as well as most of you here would understand. Thus, our focus must be on the smelting industry, although we are also examining the power industry and certain of the other sources.

As for NO_x emissions--oxides of nitrogen--these currently total only 1.2 million tons per year in Eastern Canada and about 65% of these emissions are from motor vehicles. Automobile emissions constitute a low level source of as yet undetermined significance for acid rain.

Fortunately, unlike the situation in the United States we are not projecting significant emission increases of either pollutant. Indeed, our largest source, the Inco Plant in Sudbury has cut its SO_2 emissions by more than half in the past decade. Most of our smaller smelters are well controlled, with up to 90% SO_2 removal. A new one, planned by Texas Gulf in Ontario, will have 97% SO_2 removal. As for power plants, probably only one completely new coal-fired facility, and at the outside two, is planned this whole decade throughout Eastern Canada. Moreover, this one facility, is only 400 megawatts and will burn very low sulfur coal, 0.6%. Its total emissions are expected to be less than 20,000 tons of SO_2 per year. You can, therefore, see that new coal fired power plants are not the area of focus for our attention. I might make a point, that if you want to know which one this plant is, you only have to ask the State delegation from Minnesota. In addition, there are some plans to convert some plants to coal along the Atlantic Seaboard, but at the very outside, these might total 1,000 megawatts.

I have described our physical circumstances, our contribution to the problem, and the procedures we are employing to develop the appropriate responses. Obviously, to be effective, such a response must go beyond our own borders, and it is accordingly being proposed that our two countries enter into an air quality agreement designed to address transboundary air pollution. You have, therefore, the right to know something of the will and determination of your future partner in this major endeavor. I can say to you flatly on the basis of my knowledge of the views of Federal and Provincial governments in Canada, that we are committed to bringing about major reductions in SO_2 emissions as rapidly as the systems we have put in place will allow us so to do. I have no doubt that if our principal Provincial colleagues were here with me, they would make the same point. The reason is very simple. The effects of acid rain are now sufficiently widely known in Canada and concerns on the part of the public have reached such a point, that actions to control the sources have become a political imperative at both levels of government. In short, your future partner is both willing and ready. Thank you.

Mr. Gage: Thank you very much, Ray. We now have moved somewhat ahead of schedule and I think it would be very appropriate at this time to take about 15 minutes for questions and comments from State representatives. I would just ask you to identify yourself and your State, not so much for those of us up here who can see you but for the hundred people or so who are in the back. Are there any comments at this point for any of the three speakers who have made presentations during this session? We will have a chance to have quite an extensive discussion at roughly 4:45, but I thought that since we are running a little ahead of schedule it might be well to take several questions. Well, if not, why don't we take a 30 minute break and be back at 3:15.

Mr. Gage: Our next speaker is Mr. Lowell Smith who has spent many years on the Ohio River Basin Energy Study and the problem of long-range transport and modeling. During this time, he has become widely acquainted with the many aspects of the acid rain problem. We have asked Lowell to talk about the emissions of sulfur and nitrogen oxides to open this session. Lowell.

Mr. Lowell Smith: Thanks, Steve. It is certainly encouraging to see this many people on an afternoon like today who are as interested in the acid rain problem as what we see here today. I would wager that if we held this meeting a bare 12 months ago, we would barely be able to fill the seats around the table. I think we have come a long way in a very short period of time. What Doug Costle started to talk about this morning was that we have only started to control air pollution in the Agency with the States and with the Federal government under the Clean Air Act to meet concentrations locally around power plants and other large sources of air pollution. I should not say just around power plants, we have only controlled sources to meet local ambient air quality concentrations.

This slide is what a power plant looks like and if you are standing downwind of that power plant, we see something like this. This is really what EPA is trying to control from those power plant stacks, it is what this ambient concentration of that plume downwind is. We see that plumes can travel fairly long distances--this is a shot over Lake Michigan

I believe--with a plume starting to spread out over the lake. These plumes can travel great distances.

Here in the Ohio River Basin, we see that these plumes are traveling off to your right and we see that these plumes can travel very long distances and start to merge into hazy blobs. The important point is that here we have plumes that come up from several sources and start to merge into a hazy plume and then go on for some time until on a continental scale we now see the United States here, Lake Michigan, the Atlantic Coast, and here we see the plume which has spread out over much of this part of the United States, in fact, even has been transported up in this direction. This is one large hazy air mass made up of hundreds of plumes like the one I pointed out over the Ohio River Basin.

How does long-range transport actually occur? I want to talk to you a little bit about are three points. First, how transport occurs. Second, what the atmospheric effects are. Third, how are the sources characterized.

First, talking about how transport occurs, notice this black line. It is an indication of where the inversion layer--a sort of cap in the atmosphere--is over the time of day. Here is midnight, here is noon, and midnight again. Here we see that the inversion layer during a typical summer night is very low, then as the sun comes up and stirs up the atmosphere it heats it up and mixes it, and then it rises up to maybe 1200 meters or so, and then when evening comes it drops back down and starts the process over again. The important point is that we have a stack that is a couple hundred meters high. This will shoot the emissions up into the atmosphere, rise up 300 or 400 meters and then it will be above the inversion layer. It will not come into contact with the ground till 6, 8, or more hours later when the sun starts to mix the atmosphere. That means that some chemical reactions can take place in this plume during that time. It also means that this plume can transport several hundred kilometers during that time, because frequently we see, especially in the Midwestern part of the United States, a thing called a nocturnal jet. That nocturnal jet means that at about this height there is a preferential wind velocity that increases the speed with which the pollutants are transported and keeps the pollutants in a narrow band and transported cohesively several hundred miles overnight. Much of the chemical activity, we think, takes place during the daylight hours when this plume is well mixed with all urban sources, the other source of air pollution. There is a lot of chemical activity that goes into changing those sulfur oxide and nitrogen oxide emissions into the acids that we have been talking about earlier this afternoon. Let us go on and see what this might look like for sulfur.

We see that if we have a unit amount of SO_2 coming out here, that during the first day, a large part of this deposits on the ground dry, gets caught in the trees, on the grass, on buildings and anything else that it comes into contact with. Another small fraction of it gets chemically transformed into a sulfate. This is the anions of that sulfuric acid that we talked about earlier. That is now an aerosol, a very fine particle. Part of that can get rained out (wet deposited) and a lot of it is dry deposited as well (which we are not showing on this slide). The important thought is that this SO_2 can go on for several days getting less and less SO_2 but more and more sulfate, and by the end of three or four days we see a lot more sulfate than we do SO_2. This mass of gas has now turned into a mass of particulate, which is also very acidic.

Put another way, as days go on we see that SO_2 tends to go away, sulfate tends to build up and slowly dry deposit out, and of course the bulk of it dry deposits as SO_2 or wet deposits as SO_2 as it rains or gets caught up in cloud water. The same sort of thing happens for nitrogen although the chemistry is a little more complex. Most nitrogen comes out as NO, a gas, which very quickly transforms chemically into NO_2 and then a lot of the NO_2 does deposit out rapidly but then some of it converts to NO_3 (nitrate) which is the anion of nitric acid, and that nitric acid is a very sticky molecule which will quickly deposit out on anything it comes in contact with that is dry or will get caught up in the rain water. This nitric acid stays as a molecule (really a gaseous acid if you will) instead of going into a particulate like the sulfate does. Then some of this slowly transforms into PAN (the oxidant aerosol chemistry) and that can stay in the atmosphere for long periods of time, and finally gets deposited out as well.

What is the effect of all this? The effect is that we see these hazy air masses; here is one blowing out over the Atlantic. Just to show you that this can become disassociated with the sources of the pollution which are back in this region, all this hazy air is moving out here in the satellite photograph. The effect then is that we are going to have a lot of particulates building up but those particulates are also scattering light. This is a schematic of that same satellite photograph. The gray area shows where the hazy area on the satellite photograph was. The yellow areas are where ground level visibility is less than 5 miles. That is because the sulfate scatters light and that means you cannot see through the air horizontally very far and decreases your visibility. The red area is where visibility is less than 3 miles. This means that you are unable to fly an airplane under those conditions unless you are under instrument control.

Here we see the sulfate level during the same period of time build up from 20 micrograms per cubic meter to over 50 micrograms per cubic meter in 5 years. The rest of this area is white because we simply did not have sulfate monitoring data. Our sulfate monitors, as you are probably aware, come out of our hi-vol filters which are only turned on either every 6 days or every 12 days. This area is on a 12-day cycle and this area is on a 6-day cycle. The monitors happened to be on at the right time so that we see part of where the high concentrations of sulfate were.

Well, what are the atmospheric consequences of this? First, we see that we have a lot of particulate matter around and, in fact, as we just pointed out in the last slide, 50 micrograms is one-third of the secondary PSD standards. So on that one day, one-third of what you are allowed to have over a 24-hour period was in sulfates. Very little of that was emitted near that hotspot area. Most of it slowly blew in from other areas. That means that in those areas which are measuring or experiencing high sulfates, they do not have the ability to control their TSP levels as do areas that are less affected.

A second effect is this: remember that sulfates scatter light, thereby decreasing your visibility. I am going to run very rapidly through a little time sequence of visibility trends in the U.S. The areas in white have a summertime visibility. The average summertime day visibility is greater than 10 miles. The yellow areas are areas where the summertime visibility is between 8 and 10 miles. We see a little area over Washington, D.C. where the summertime visilbility is between 6 and 8 miles. In something like 15 years, these areas have spread out quite a bit. We see that over a 20 year period we have a whole new area where the summertime visibility on the average day is less than 6 miles. That means that over a period of 20 years we have gone from over 10 miles visibility on the average summertime day almost everywhere in the Eastern U.S., to a fairly large area where visibility is less than 8 miles and in many areas less than 6 miles on the average summertime day. A lot of that is due to sulfates, not all of it, but over half.

This slide shows what the impact on visibility would be if you were a vacationer up in the Adirondacks on some of the white mountains. This would be the view on a fairly good-seeing day when the visual range is 30 or 40 miles. Forty-eight hours later, the visual range has dropped down to less than 3 miles and yet this is not fog. Nothing obvious is happening except that a hazy polluted air mass blew in. Remember this is an area which the State of New York decreed in their constitution should remain forever wild. I do not think that is a very wild picture that we are seeing.

The third point I want to make in terms of the atmospheric effects, besides the particulates and the visibility, is simply what we get after depositing out. We have already talked about that so I am not going to spend more time on it. I want to tell you more about the source of these emissions. This is the latest data that we have showing the source of nitrogen oxides emissions. Notice that a large portion (just over 40 percent) are from transportation sources, mostly automobiles. These are only for the U.S. not Canada, Ray. We see that another major portion (a little over 30 percent) comes from the electric utilities sector and still another good size portion (more than 20 percent) comes from industrial combustion, then we have all of these little nickel and dime portions thrown in as well.

If we were to look at the SO_2 emissions, we would see that the electric utilities sector is by far the major contributor. About two-thirds of the SO_2 emissions in 1978 came from that one sector. Ninety percent of these emissions came from coal-fired power plants. The next largest sector is the industrial combustion sector, and I do not remember the number, but the majority of these emissions are coal-fired emissions for rising industrial steam. Other industrial processes, primarily the nonferrous smelting industry, are responsible for less than 10 percent and most of these are not in the area we are concerned about. These, of course, are in the Southwestern U.S. Also, residential oil burning and other sources contribute as well as various miscellaneous sources such as oil refineries, etc.

This slide--I will apologize to you--did not come out as I had expected. I wanted to show you these things stacked on top of each other--the trend of these emissions over time for the total amount of emissions. Here we see that these unimportant factors really have not been having any major trends from 1940 to 1978. But we do see that three sectors are industrial combustion post-1960; electric utilities, post-1940; and transportation post-1940. Notice that there is a cut here; there are 2 million tons per year of emissions cut out; that is why we have the break. The important thing is that when you start adding all these up on top of each other, the nitrogen oxide emissions are rising very rapidly in time. Unfortunately, we see little to suggest that they will not continue to rise. However, in the future there are some promising technologies which you will hear about from Steve Reznek that will suggest that we can at least start to turn the corner in the future. That is at least several years off.

In terms of the SO_2 historical emissions, again we see that the less important ones have not been doing much over time, except that the commercial-residential sector has declined from 1940 to 1978 simply because most of the people do not want to burn coal in their store furnaces or in their home furnaces. There is still, in some few States, a significant amount of residential coal combustion which accounts for most of this residual. The very striking thing is that industrial combustion has declined dramatically during this time period. More than offsetting it is the electric utility sector which has been growing very rapidly from less than 3 million tons of SO_2 in 1940 to over 19 million tons of SO_2 emitted per year in 1978. Again, I will caution you that there are about 6 million tons per year cut out of this graph so that we could get it all on one slide. The overall total trend, which is not shown here, is that SO_2 emissions rise slowly between 1940 and 1970 and then remain roughly the same from 1970 to 1978 due to the great decrease in emissions from these two sectors offset by the strong rise in the electric utility sector. We are a bit more optimistic for SO_2 emissions in the future. We think that we are close to turning the corner, depending on the electric utility sector. There are many uncertainties in predicting that behavior but we see that we will be able to cap those emissions and hopefully see them reduce before the end of the century, under current operating conditions.

Let us see where the emissions come from. NO_x emissions are strongly dependent on autmobiles so that every place there is an automobile, like in Chicago or New York, we see strong amounts of NO_x. For those of you who cannot see it, the yellow squares are less than 10 grams per second. This goes up expodentially, so that the green is 10 to 100; light blue is 100 to 1,000; dark blue is 1,000 to 10,000; and the purple is more than 10,000 grams per second in this 80 by 80 kilometer grid cell. The other point that you should notice from this slide is the area where electric utilities are concentrated such as along the Ohio River Basin, especially in the upper part of the Basin where we see a large continuous block of NO_2 emissions which are unbroken by spaces such as you have down in the Southeast. Areas like this give little chance for the area to cleanse itself as it goes from one high emission square to the next.

If we look at the SO_2 geographic distribution, again we have this expodential scale where yellow is less than 10 running through purple which is greater than 10,000 grams per second. The single largest SO_2 emission point in the North American Continent is this square up here. That is one smelter. However, the two highest emitting grid squares on here are this grid square and this grid square. That is because these have enough power plants in them that they more than account for the amount of emissions from this one isolated emitting point up here. In fact just before I came here, just for the fun of it, I did a simple little calculation any of you can do--assume that the depth of the air that these emissions have to mix into is one kilometer thick. That is roughly 2,000 feet which is a little high for a mixing layer, and this is about 20,000 grams per second going into each of these grid squares. Very quickly you come to the conclusion that if there is no transport of air into or out of these grid squares and if there is no deposition of sulfur going on in the atmosphere, that within a day, or a day and a half, the U.S. primary SO_2 standard would be exceeded in these grid squares simply from that rate of emissions alone. So, we can be very thankful that deposition does take place; we can be very thankful the winds do blow; but, we have to consider what are the effects on other grid squares. That is the point of this conference. Thank you for your attention. (Slides were not made available for publication)

Dr. Gage: The next presentation will be a movie or rather an edited version of a movie prepared by Dr. Walter A. Lyons. Dr. Lyons is the President and founder of MESOMET, Incorporated, which is an environmental and meteorological consulting firm in Chicago. Dr. Lyons received his PhD from the University of Chicago and taught at the University of Wisconsin for some years. He is the former chairman of the American Meteorological Society Committee on Air Pollution Meteorology and has published more than 50 papers in the area of pollution transport. I will let Walter introduce this short movie which has been receiving rave reviews around the world. Walter.

Dr. Walter A. Lyons: There are a number of comments I could make. This is a "dirty movie" that is rated R for Research. The first such movie was produced last year, basically as part of a technical planning conference at EPA in Raleigh. It went over very well--so a book was produced by EPA, and since widely distributed. The "Anatomy of an Air Quality Episode" was so popular, like "Jaws", that we now have the "Blob" movie as it has been nicknamed.

I would have to say that if repetition is the mother of learning, I am going to come out with several motherhood statements here because many of the things that have been said, I am going to repeat.

This film was produced both as a generic description of the entire topic of long-range transport and it also highlights the use of several new technologies, or I should say, old technologies being used in new ways. It, furthermore, produces an inkling of what will be transpiring this summer in a major field program called PEPE 1980. If we can dim the lights first and start the projector.

This is the Eastern United States--and you have seen this picture before--what is visible are not water clouds but clouds of pollution.

We are going to discuss satellite observations of what are now being called "persistent elevated pollution episodes" or, the acronym PEPE.

A preface. The Clean Air Act directed concern toward many sundry effects of air pollution on health and welfare. Part of this effect is to examine the transboundary transport, and how to model it effectively so that we can develop effective control strategies. With this goal in mind, EPA will conduct an experiment this summer, called PEPE-1980 to better quantify long-range pollution transport and transformation.

We turn to White Face Mountain in the Adirondacks on August 26, 1977. As Lowell Smith pointed out, it took a shift in the wind and only 48 hours for visibility in excess of 30 miles to deteriorate to less than 5 miles. Unfortunately, this is not an infrequent occurrence but a common one throughout much of the Eastern United States. Computerized trajectory modeling shows that on the first of these days the "clean" air was coming in from polar regions--from Canada. In the subsequent 48 hours the trajectory analysis shows the air started avecting from the southwest--from the large industrialized regions of the Eastern United States. The trajectories, I think, speak for themselves.

Ten years ago after the passage of the Clean Air Act and its Amendments, much attention was given to the control of localized point sources; power plants being, of course, one of the favorite targets. We were scrutinizing the first 10, 15, or 20 kilometers downwind, and the sulfur dioxide impact on those receptors. Various field programs began to extend the view a little bit further. For instance, the MISTT program in St. Louis. A plume from a large power plant, the Labadie plant, located north of St. Louis, Missouri, was tracked by aircraft. Under certain preferential meteorological conditions, that plume was observed to move cohesively for over 300 miles into Southern Minnesota. Long-range transport and then some. Of course, it does not exist in isolation all by itself. There were many other sources of sulfur dioxide as well as other pollutants in the vicinity. When you aggregate these together, you do not normally just have a single plume but a conglomerate of plumes, an urban plume if you will, which can blow in this direction, or any direction that the prevailing low level winds are carrying it. Of course, even though we are emitting a given pollutant--by various chemical transformation processes--results are a myriad of secondary pollutants. That is really what we are concerning ourselves with today.

The oxides of sulfur and nitrogen, especially in warm, humid air masses, in the presence of sunlight, are transformed into a veritable "chemical soup." Some of the constitutents we know well, others we are just now beginning to monitor. With the right filtration, a time-lapse camera system allows one to literally see the clouds of pollutants--particles, liquid sulfuric acid mist, and other particulates--continually drifting by with the prevailing winds.

An urban environment does not exist in isolation, it is surrounded by other urban environments. During a typical summertime episode, when North America experiences a stalled high pressure system, these begin to coagulate and to accumulate. These combined urban plumes are what has been called a "blob," a "smog blob," a "hazy blob," or a PEPE. If you examine day to day the satellite pictures, they can be seen in one area as it avects with the low level winds into another. The episode may also continue to build southwards, move northwards into Canada, and usually only ends after a cleansing cold front sweeps through from the west or to the north.

Now Lowell Smith already has gone into great detail about sulfur dioxide, but perhaps if you just look at a very simplified map of these sources it brings the point home that anywhere in the Eastern United States, nobody is really all that far from the very major source regions, particularly a high stack source of pollution. There are many major sources and many, many smaller sources. Now it may be just a few tens of kilometers or it may be a thousand kilometers or more, but the atmosphere clearly has the capability of dispersing pollutants that far. The leading four States in terms of total tonnage, Illinois, Indiana, Ohio, and Pennsylvania, are not alone because they are surrounded by other States with lesser but still very significant contributions. Essentially, we are all breathing each other's emissions, in fact, we are suffering "the sins of emissions" of others (pun intended).

This is Chicago on a typical day in August 1976, and unfortunately we could not blame this pollution on Gary, Indiana. This is a widespread air pollution episode with visibility less than several miles extending over many States. It is very interesting to watch the pattern of airport visibility reports from the 17th to the 28th. These areas in orange are visibilities less than 5 miles. These make a very good surrogate for sulfate aerosol concentrations and other related pollutants. For the first several days, little happens. You have a few random patches of low visibility but after several days of "cooking," a massive area of 5, and now less than 3, miles visibility begins to appear. An area of pollution stretching from Louisiana up through Lake Superior out through the Middle Atlantic States and well into the ocean persists for several days at a time, waiting until on the 28th a very strong Pacific cold front moved through and blew the entire mass into the Atlantic, and, of course, we are not sure how far it kept going.

Keep in mind that a PEPE, a persistent elevated pollution episode, is many things. It is a region of high sulfate aerosol concentrations, producing low visibilities, almost always associated with elevated ozone levels and is the stuff of which acid rain is made, or at least a significant contributor. It is not an urban problem, it is widespread. In fact, we turn to the satellite to show us how widespread.

What do satellites really see? First of all there are many types of satellites. The one we are referring to is a geosynchronous satellite--one that stands over the equator and allows us to see the entire earth at a time. These pictures are taken in the visible and infrared portion of the spectrum every 30 minutes allowing us to produce animations if desired. It is in the visible spectrum, closely matching what we would see with our own eyes, that we get the most interesting information. Two satellites are monitoring the United States, GOES East and GOES West. There is a similar one called METEORSAT which is monitoring conditions over Europe. It is part of a satellite global network.

You will perhaps get a better idea of what the satellites can show us by looking at this animation. Here is a static image at one o'clock on a summer afternoon showing clouds over Oklahoma, Arkansas, and Missouri, but with the tremendous increase of information we can obtain by animating these images, we can see the morphology, and the dynamics of the atmosphere. We begin to realize how incredibly complex things are, how air moves at different levels, the different directions at different levels, how thunderstorms can boil up and ingest air from the lower 2,000 or 3,000 feet and spread it over the 20 or 30 or 40 or 50,000 feet of the atmosphere, involving low level air masses in the precipitation mechanism in a most complex four-dimensional manner (the fourth dimension being time). So we begin to realize we have new ways to view things, that animation is important as an analysis tool. Just being able to see the geographical extent of aerosols is most helpful.

Here is a forest fire in Los Angeles (it is either floods or fire that appears out in this area). In November several years ago, severe fires occurred in the mountains surrounding the Los Angeles area and by animating the plume you can clearly see advection of several hundred kilometers into the Pacific Ocean. There is no doubt about the reality of long-range transport of particulates in high concentrations. Perhaps ten years ago, we would have doubted that the smoke in this case could have traveled that far in such high concentrations but that argument has long since ceased.

Now, it is really no surprise if you fly above the Ohio Valley on a typical summer day and you look down and do not see the ground, because of the tremendous amount of reflected light from the sulfur aerosol haze and whatever other constituents are there. It is no surprise that if we can see it with our naked eye from an aircraft that we should be able to see it from a satellite image which is designed essentially to see reflected light. But first we would like to dispel a myth. In the textbooks it says weather moves from west to east. This has already been alluded to. If we go up to the jet stream we find that ribbon of air which separates the polar air masses from the tropical air masses happens to be at 30,000 feet, and, yes, air trajectories do move in a general west to east direction although they can become highly convoluted. They do have a tendency to steer the high and low pressure systems across our television weather maps, but keep one thing in mind. If you check further in your basic meteorology textbook, the air around a high pressure system rotates clockwise. Air can move in any direction around a high pressure system depending on where you are. If one checks the literature, one finds various long-range transport episodes reported in Florida, in the maritimes of Canada, even intrusions as far west as Oklahoma and Kansas. Episodes can, and do, and will continue to impact any given area from virtually any direction, depending upon the prevailing meteorological conditions. So, therefore, virtually every receptor can be impacted from any source in an airshed which stretches from eastward 100 degrees west longitude.

An anatomy of a typical "smog blob" or a PEPE. A high pressure system may drift out of Canada, initially very clean, but the circulation around it begins accumulating myriads of pollution plumes over a wide area. They undergo several days of transport--photochemical conversion--and by the time it has extended to its maximum aerial coverage, the episode may blanket the better part of 20 or even 30 States. We are all "in the soup" together.

A major episode occurred from the 21st of June to the 6th of July 1975. Over a three-week period, much of the Eastern half of the United States was engulfed. Computer predictions of sulfate concentrations suggested that by the 29th of June a huge area would have experienced exceedingly high sulfate levels, therefore, low visibilities, and probably (by inference) elevated ozone values. By the next day, the 30th, the enhanced satellite imagery did reveal a vast area of haze stretching through this region. It had now shifted, not to the east, but to the west. Why? Because the high pressure system was centered over the Great Lakes. Visibility contours of less than 5, 3, and even 2 miles, are predominate from Arkansas, up into western Missouri, Iowa, and into Minnesota. Ozone levels in excess of 160 parts per billion (peak hourly afternoon values) were recorded in the hazy air mass. The limited sulfate data we have for this day indeed show elevated sulfates throughout this entire region. This was in fact, a very typical episode.

This movie print has suffered somewhat from reprinting and has lost a little contrast but I would like to show you a satellite animation of that episode on the 30th of June. The whiteness visible throughout the central U.S. is sulfate haze, with corresponding elevated ozone and reduced visibility. Notice the general flow of the pollution from Pennsylvania through Ohio, Tennessee, Kentucky, down to Alabama. Then it makes a sharp turn and begins moving northward through portions of Arkansas, Eastern Oklahoma, Missouri, Kansas, up through Iowa and into Minnesota. Most interesting, between St. Louis and Kansas City, there seems to be a "dark spot" in this overall bright, hazy air mass. This apparently is air with reduced aerosol concentrations due to the involvement of that air in thunderstorms perhaps 12 hours ago. These white spots are thunderstorms ingesting massive amounts of low level air and, therefore, sulfate aerosols which make excellent cloud nuclei. They are becoming involved in the cloud and, presumably the precipitation mechanisms, with resultant wet deposition--acid rain. It is a complex, four dimensional phenomenon, but we can see clearly in the satellite image the "footprint" of what is probably an acid rain event.

We move north on that day into Minnesota. Notice the tremendous flow of polluted air from the south. Ozone values on this day were the highest ever measured in the State (in and around central Minnesota). Thunderstorms with precipitation in excess of 18 inches fell in Northern Minnesota as that polluted air mass fed into those thunderstorms. What rain did not become involved in the precipitation mechanism undoubtedly moved through the Boundary Waters Canoe Area into Canada.

This different view provides the realization that Eastern North America is one large, complex airshed.

What are the effects? Well, many of these effects have already been alluded to. Certainly, there are known effects on aquatic ecosystems, forest growth, and we are worried about possible effects upon important agricultural crops. Even if the sulfur being deposited during a particular episode is helpful to certain crops, it may coincidentally be associated with high levels of injurious ozone. The different pollutants do not "attack" as isolated incidents--they occur simultaneously, with possible unknown, synergistic impacts. We take note of several epidemiological studies. Urban dwellers spend much of their time inside. Yet certain sectors of the population spend considerable time outside such as farmers and children at camp. Also aerosols have been shown sometimes to be significantly more acidic in rural areas than in urban atmospheres. There are many differences which we have to contend with.

And what about weather modification? Note this thin band of haze across Florida. The computer can enhance the image to better define it. A very definite band of dense haze which came in from the Northeast, across the ocean (and probably originated in the Middle Atlantic States) was bright enough to absorb and reflect significant amounts of the sun's radiation so that in the afternoon, thunderstorms formed both north and south of it but not under it. This is a clear impact on local weather as a result of man-made haze. During July 1978, a widespread episode caused the oceans and coastlines of the Eastern U.S. to be virtually invisible in the satellite images for several days. This line of thunderstorms "chews" polluted low level humid air masses--the result is acid rain. But do not forget as it has been pointed out many times, even where you do not have these aerosols involved in the precipitation mechanism, there are significant quantities of dry deposition.

Time-lapsed films of the thunderstorm reinforce the opinion that we not only have to look at the horizontal motion of air but also its tremendous vertical displacement. These aerosols become involved in the cloud and precipitation mechanisms.

Acid rain has been shown to be highly episodic. As we begin to look at acid rain systems with radar in the same way we monitor haze systems with satellites, we may be able to find distinct differences in acid rain episodes. We now discuss some of the technology that is being brought to bear, such as the McIDAS system. This computer is attached to an antenna at the University of Wisconsin which is directly receiving digital data from the GOES satellite. McIDAS stands for the Manned Computer Interactive Data Access System. It is a very complex system which has been developed over the last 10 years in response to many research needs. The hardware, and particularly the software, allows research meteorologists to take real time satellite data, to analyze and manipulate it, and to display it in video form while overlaying real time meteorological data. McIDAS is going to form an integral part of this summer's upcoming PEPE-1980 program where we wish to measure, track, and detect the growth of these PEPE's or hazy blobs, and to make actual specific quantitative radiometric measurements of the brightness of the air mass which can be used as a surrogate for sulfate measurements.

This view is directly off the television display screen of the system at 2030 Greenwich Mean Time on August 26, 1976. If you are having trouble locating yourself, we will ask the computer to tell you where you are. We will start drawing in the boundary. There is the East Coast of the United States up into the Washington area and Long Island. This is not a water cloud but a cloud of turbidity associated with a major, large scale episode which stretched, as I mentioned, from Minnesota to east of Bermuda. It may be hard to see on this print, but by using the cursor, we were actually asking the computer to pick out the digital values of brightness. How bright is this image? How much of the sun's light is being reflected back into space? Seventy digital counts-- that is on a scale of 1 to 256. We find that over the dark water, we get a very strong signature of these polluted air masses--in this second measurement 80 digital counts. As a check, let us move the cursor down over the "black" water, the unpolluted area south of this very sharply delineated "smog front." The results--only 40 digital brightness counts. A very definite and measurable impact on atmospheric brightness is, therefore, recorded. This tells us something about the concentrations of the aerosol and gives us quantitative ways to map it. As we mentioned, as acid rain is occurring, we can now take a real-time satellite picture of an episode, in this case in Wisconsin, Minnesota, and portions of Ontario. We can overplot temperatures, visibilities, or surface wind stream lines. We could use McIDAS to direct aircraft research so they sample events more efficiently. McIDAS operators could also look for developing thunderstorms which may be ingesting large amounts of polluted atmosphere, and consequently, a highly episodic acid rain event.

In retrospect it is interesting to go back to an image that was taken in 1974. We have long had the ability to use satellites to map these large scale PEPE episodes. Again along the East Coast of the U.S., from Boston to Washington, we could see this temendous polluted air mass drifting off shore for over 1,000 miles. We do not know how much further it goes because satellite coverage ends there. Yet I suspect that if we were able to pick up the current European satellite imagery, we would indeed detect, on occasion, the transport of significant amounts of aerosols across the Atlantic Ocean (if it did not become involved in any sort of washout mechanism).

We have presented here simply a synoptic review, trying to give you, with a couple thousand pictures, perhaps saving a couple million words, a "feel" for the temporal and spacial scales of the events and to emphasize the fact that our atmosphere is a giant "chemical soup," in which, there are many interrelated processes occurring simultaneously. You cannot look at acid rain as independent of ozone or of sulfate problems. They are many facets of a single problem. Thank you.

Dr. Gage: Thank you, Walter. Our next speaker is Dr. Kenneth Demerjian, who is in charge of much of our modeling work, particularly that related to the long-range transport of air pollutants, at the Environmental Sciences Research Laboratory, EPA, Research Triangle Park, North Carolina. Ken will give us an overview of mathematical models that predict the transport and deposition of acid rain with particular emphasis on some work which pioneered in Europe well ahead of the efforts here in the United States. Ken.

Dr. Kenneth Demerjian: What I would like to do today, is discuss with you some of the research and development activities in regional air quality simulation modeling underway at EPA in the Office of Research and Development. In particular, I will discuss some results from the ENAMAP-1 Model (Eastern North American Model for Air Pollution) under contract with SRI, International. ENAMAP-1 is a modified version of the original European Model EURMAP developed for the Federal Republic of Germany by SRI, International. The Environmental Sciences Research Laboratory research program in long-range pollutant transport modeling is multifaceted in nature. The major objectives of the program are to expand upon our basic understanding of the various chemical and physical processes occurring in the atmosphere and develop models which capture the essence of these processes to provide realistic descriptions of the relationship between pollutant emission sources and receptors. As you have seen from Dr. Lyons' presentation, the complexities of the dynamic atmosphere as it relates to transport and dispersion phenomena presents a formidable task to the air quality modeler. Our mission is to develop a sufficient level of understanding to construct theoretical approaches to treat these critical phenomena within modeling. The goal is to develop creditable scientific relationships capable of providing decisionmakers with the information necessary to assess air quality impacts for given emission control strategies. The program is designed to expand our regional models to meet the evolving needs of the Agency.

Currently, regional studies have been focusing on the long distance transport of ozone, in which case, we are concerned about the transport and transformation of precursor emissions (hydrocarbon and NO_x) and ozone over various sections of the country and, in particular, the Northeast Corridor (Baltimore-Washington, D.C. to Boston). The transport of precursor emissions and ozone across State boundaries is of special interest. The model development program meets basic needs not only for regional oxidants but provides the framework for treating all other long-range transport problems, such as acid precipitation. The chemical formation processes associated with sulfur transformation into sulfate are not significantly different than the processes that are involved in photo-oxidation cycles of hydrocarbons and NO_x and actually are a necessary prerequisite to the treatment of SO_x chemistry.

In addition to the continuing research of these processes, we also have been looking at existing technologies and how they may be utilized in near-term applications to address the problems of today. The ENAMAP-1 Model is an example of such an application. The model covers a section of the country from 30 degrees north to 50 degrees north latitude, and 105 degrees west to 65 degrees west longitude. The schematic on the first slide identifies the important factors which have to be understood in order to model the impact of emissions on air quality as well as its impact on receptors in the area. It is quite easy to draw one of these figures, the difficult part is developing theoretical formulations which provide a scientifically creditable explanation of the process.

Much of the work underway is designed to study individual phenomena that contribute significantly to the regional modeling problem both in terms of transport and dispersion, as well as the processes of deposition and chemical transformation. The model, developed by SRI, that I am going to discuss is a long-range trajectory type model. The basic assumptions of the model and a schematic of its operation is presented in the following two slides. In the U.S. version, emissions inventories have been gridded on an 80 kilometer by 80 kilometer basis. The emissions inventory is based on the National Emissions Data System (NEDS) information, and has been augmented with refined utility data compiled for the Electric Power Research Institute. The combined inventory has been incorporated into this model. The model assumes that 12-hour averaged increments of emissions are released into circular puffs of the order of the 80 kilometer grid. They are then transported in 3-hour intervals with certain assumptions regarding the dynamics of the atmosphere. First, the atmosphere is assumed well mixed in the vertical and is bounded by the average mixed layer height on any given day. Dispersion in the horizontal is based on a Fickian theory, and assumes a t 1/2 functional form for puff expansion. The chemistry is first order in SO_2 transformation to sulfate. The first order rate constant is based on best estimates, considering both the photolytic and heterogeneous transformation processes. Dry deposition for SO_2 and sulfate are also first order processes. The wet deposition of SO_2 and sulfate are linear, but are related to the precipitation rate that is empirically based on observational data. The puffs are transported based on the 850 milibar upper air wind observations processed through an objective analysis routine, and averaged over 3-hour increments.

The next slide highlights the major element values for processes used in the model. The loss rate for SO_2 by dry deposition is assumed to be 3.7 percent per hour. The wet deposition rate is a function of the precipitation rate which is inputed into the model. The factor 0.28 times the precipitation rate gives the actual wet deposition rate within the model. The transformation of SO_2 to sulfate is 1 percent per hour, based on a 24-hour average. All values chosen are best estimates based on current information in the scientific literature. The model does not consider NO_x or nitrate chemistry, but we are currently considering a developmental effort to include these processes.

The gridded region of the model shown in the next slide is the 70 by 70 kilometer receptor grid. It covers portions of Eastern North America and the United States. Calculations on individual grid cells are available, but for computational and interpretational convenience, the region has been blocked off into sectors. The next slide shows the various sectors in the model. The model application considers each individual region to assess not only its localized impact on itself but the interregional exchanges that it has with other sector regions in the modeling domain.

The following results are analyses of two sets of case studies based on results reported in SRI, International's final report to EPA available within the next month. Before discussing those results, the following slide shows a sample output from the model, in this case SO_2

isopleths over the modeling region. In the handout presented today, you will find comparisons given between SO_2 concentrations from the model and observations from the Storage and Retrieval of Aerometric Data (SAROAD) and Sulfate Regional Experiment Program (SURE) networks. The results presented are monthly averages for August 1977. The model gives both ambient concentrations of SO_2 and sulfate as well as deposition fields for SO_2 and sulfate both in terms of dry and wet deposition. The model also computes and compiles tables of interregional exchange for each one of the parameters above. An example of such a table is presented in the handout.

The first example shows annual average depositions for the three major receptor regions in the year 1977. This is total sulfur deposited. The three regions of highest total deposition are Region V south, Region II and Region IV north. The interesting conclusion drawn from these results is that at least 50 percent or more of the total sulfur deposition contribution, within these regions, comes from the region's own emissions.

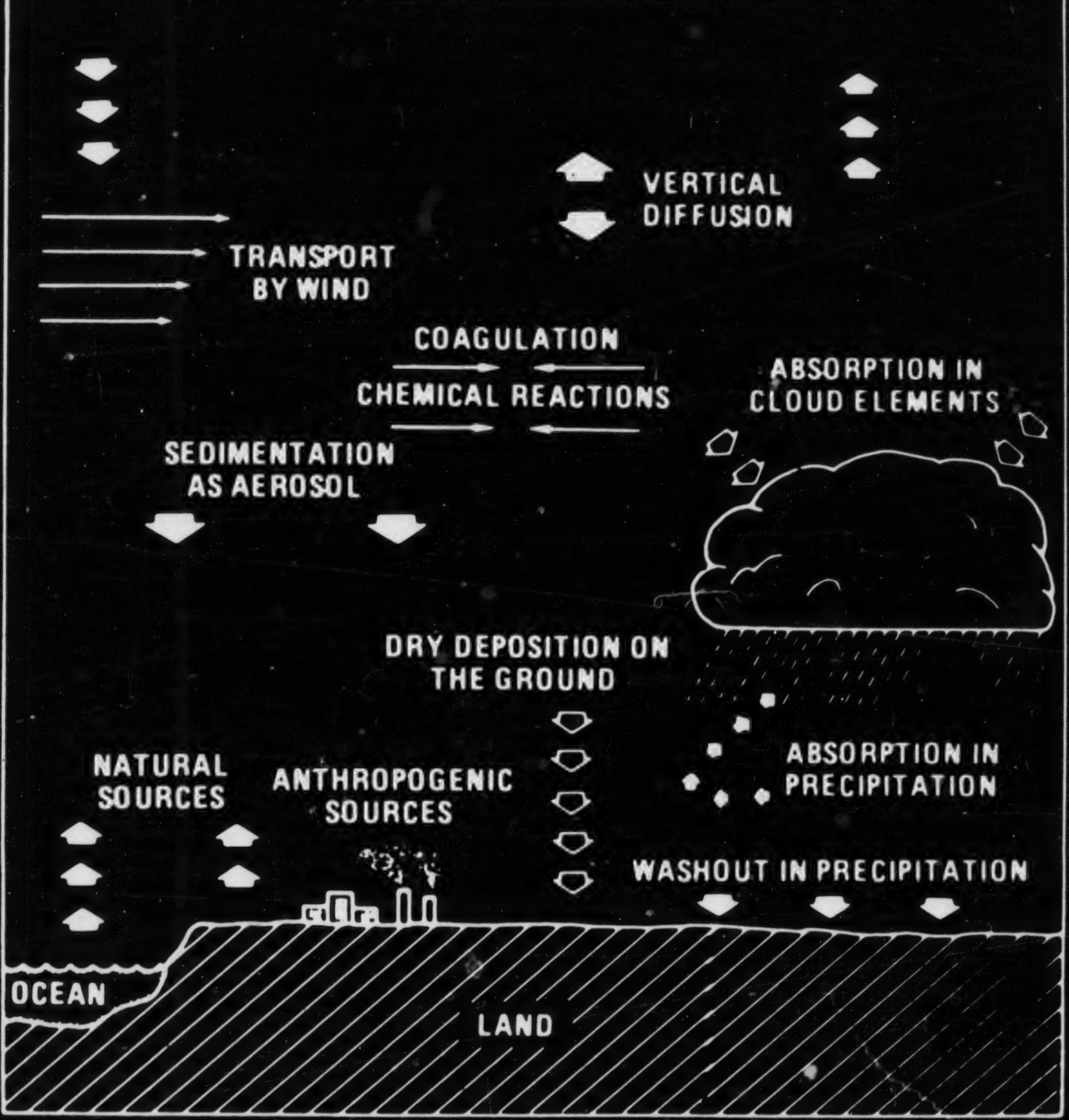
This result makes physical sense in that SO_2 is dry deposited at a fairly high rate, therefore, its lifetime in the atmosphere is rather short compared to that of sulfate. Therefore, major amounts of SO_2 emissions are taken out of the system rather quickly, so the region gets back the SO_2 emitted fairly quickly through dry deposition processes. Remember that the rate of dry deposition is 3.7 percent per hour, the transformation rate is 1 percent, and the sulfate deposition rate is less than 1 percent per hour. Total sulfur deposition is dominated by dry deposition of SO_2, shown in the hestogram. Contributions by other regions to these sectors do exist, but they are not the dominant factor.

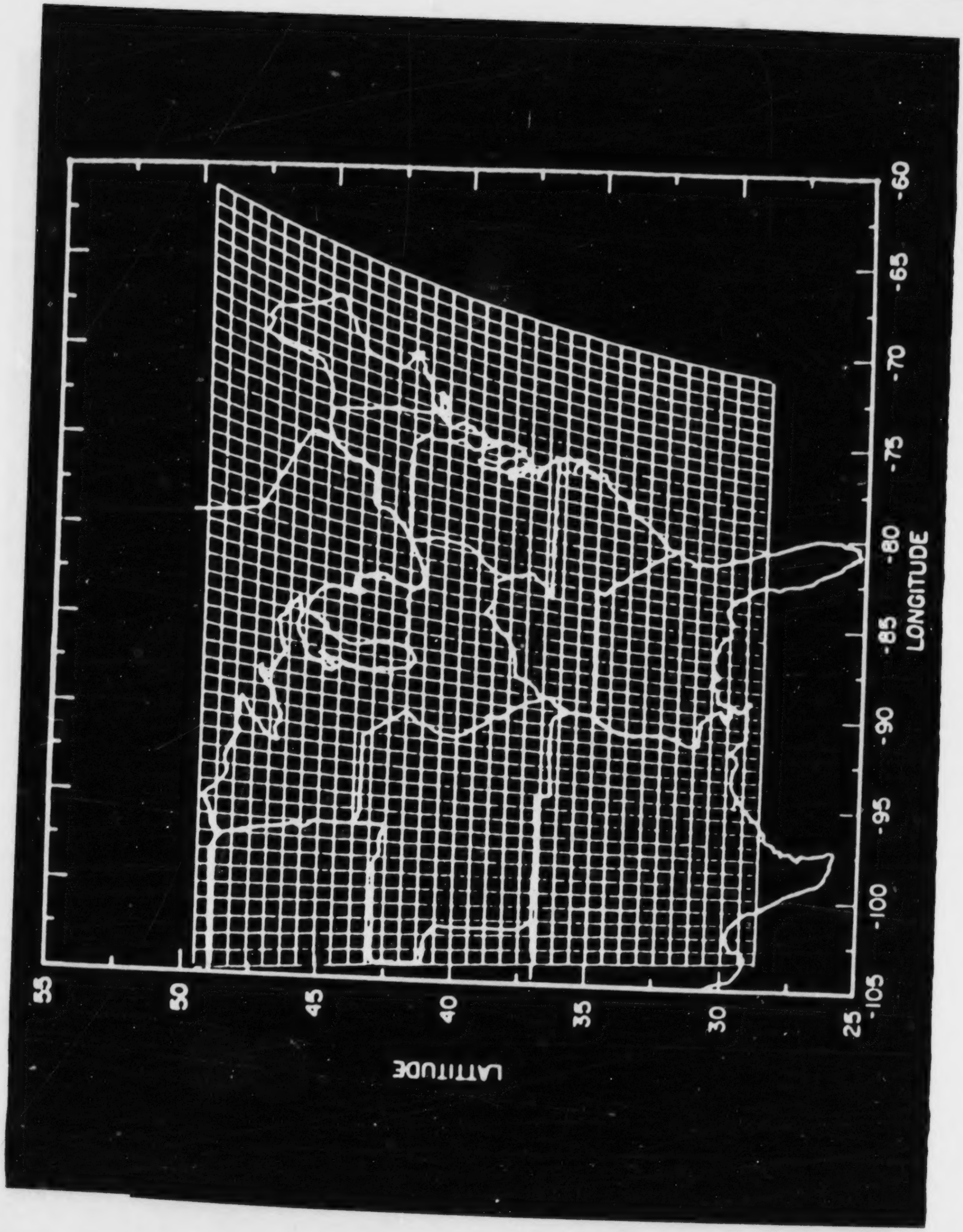
In the next slide, analyzed results for dry and wet sulfate deposition are presented. In this case, we are considering the sulfate components only. Presented on this slide are the three highest receptor regions for wet and dry sulfate deposition for August 1977. The results have been unit area normalized to mitigate the varying size of regions. The highest three regions for sulfate deposition are Regions II, III, and I in order of decreased magnitude. The interesting observation in this particular case is that the self contributing component is not of significance, except possibly for Region III. Major contributions in Region I and II are from other regional sectors.

Upon reflection, these results seem quite reasonable. Since sulfate is a long lived species in the atmosphere, due to its slow chemical formation and deposition and its chemical stability, it is available for transport for longer time periods. One of the interesting problems that will have to be addressed in the near term is our ability to better understand this phenomena, and other phenomenological processes that contribute to long-range transport in the atmosphere.

One other important point that must be made is that these results do not indicate anything about the acidity of the sulfate. They only address sulfate deposition. The model is not capable of dealing with the chemical processes related to the composition of the sulfate. Such detail can only be considered in complex theoretical models currently under development in our program. We are currently performing research studies aimed at resolving major contributions associated with the regional transport problem. These include cloud invection processes in terms of their ability to pump pollutants from the lower atmosphere into upper layers of the atmosphere, heterogeneous processes within clouds affecting chemical transformation, better estimates in dry deposition rates, and the compositional aspects of sulfates and nitrates in the ambient atmosphere. With that, I would like to conclude my talk.

PATHWAY PROCESSES OF AIRBORNE POLLUTANTS


VERTICAL DIFFUSION
TRANSPORT BY WIND
COAGULATION
CHEMICAL REACTIONS
ABSORPTION IN CLOUD ELEMENTS
SEDIMENTATION AS AEROSOL
DRY DEPOSITION ON THE GROUND
NATURAL SOURCES
ANTHROPOGENIC SOURCES
ABSORPTION IN PRECIPITATION
WASHOUT IN PRECIPITATION
OCEAN
LAND



LATITUDE
55
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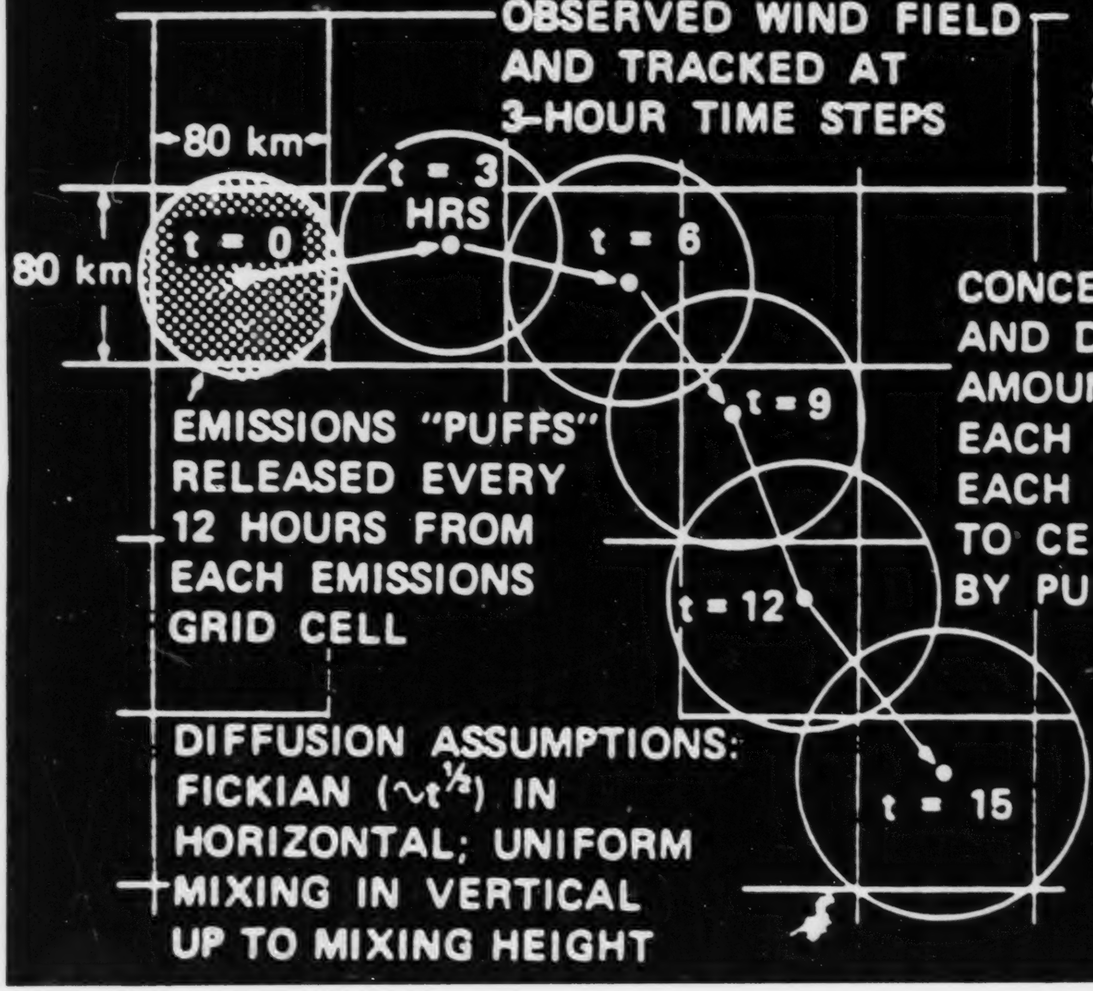
45
40
35
30
25
LONGITUDE
-105
-100
-95
-90
-85
-80
-75
-70
-65
-60

EMISSIONS PUFF ADVECTION AND DIFFUSION SCHEME



PUFFS ADVECTED WITH
OBSERVED WIND FIELD
AND TRACKED AT
3-HOUR TIME STEPS

$SO_2 \rightarrow SO_4^=$
AT ASSUMED
RATE OF 1%/HR

CONCENTRATION AND WET
AND DRY DEPOSITION
AMOUNTS ASSIGNED TO
EACH RECEPTOR CELL AT
EACH TIME STEP ACCORDING
TO CELL AREAS COVERED
BY PUFF

EMISSIONS "PUFFS"
RELEASED EVERY
12 HOURS FROM
EACH EMISSIONS
GRID CELL

DIFFUSION ASSUMPTIONS:
FICKIAN ($\sim t^{1/2}$) IN
HORIZONTAL; UNIFORM
MIXING IN VERTICAL
UP TO MIXING HEIGHT

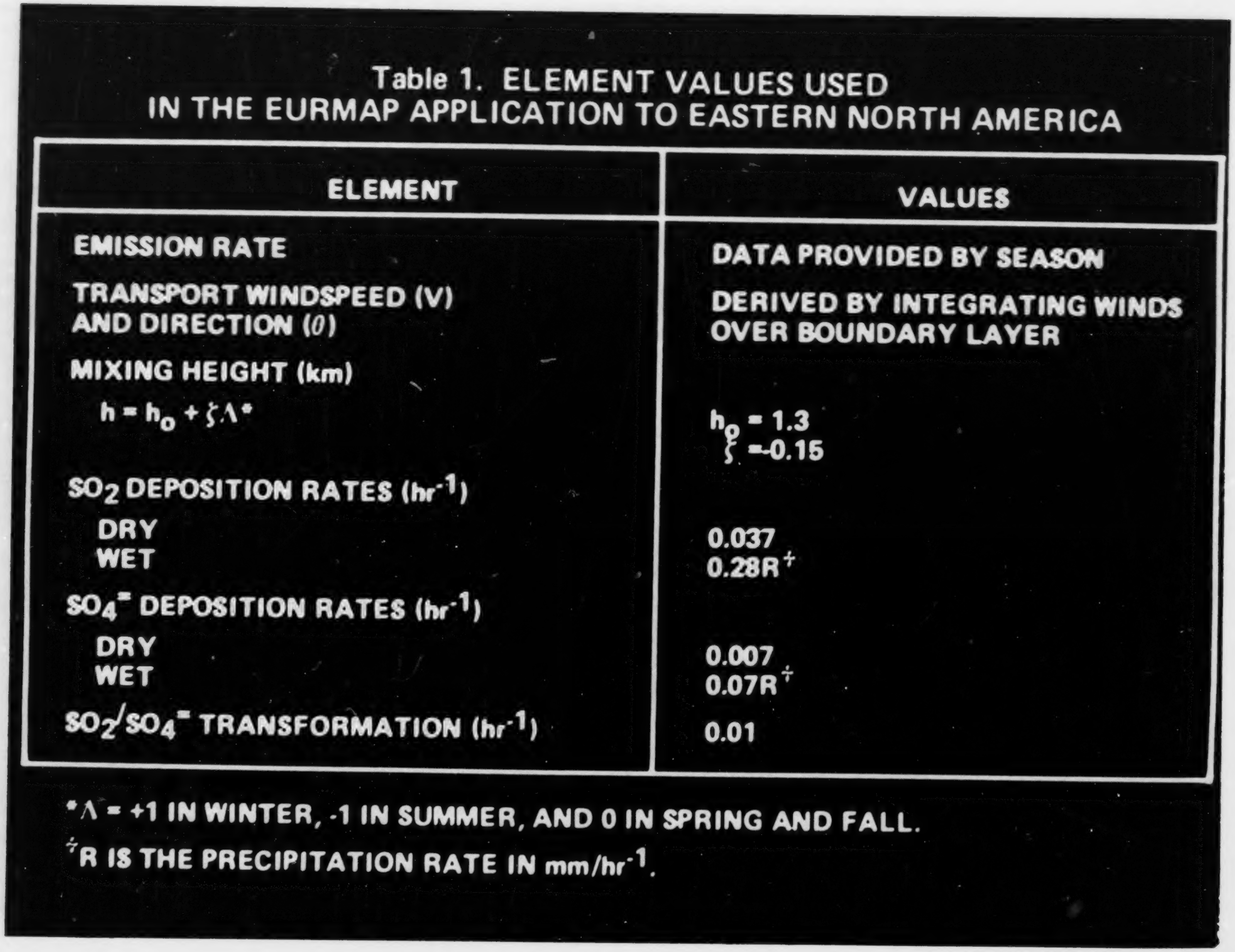
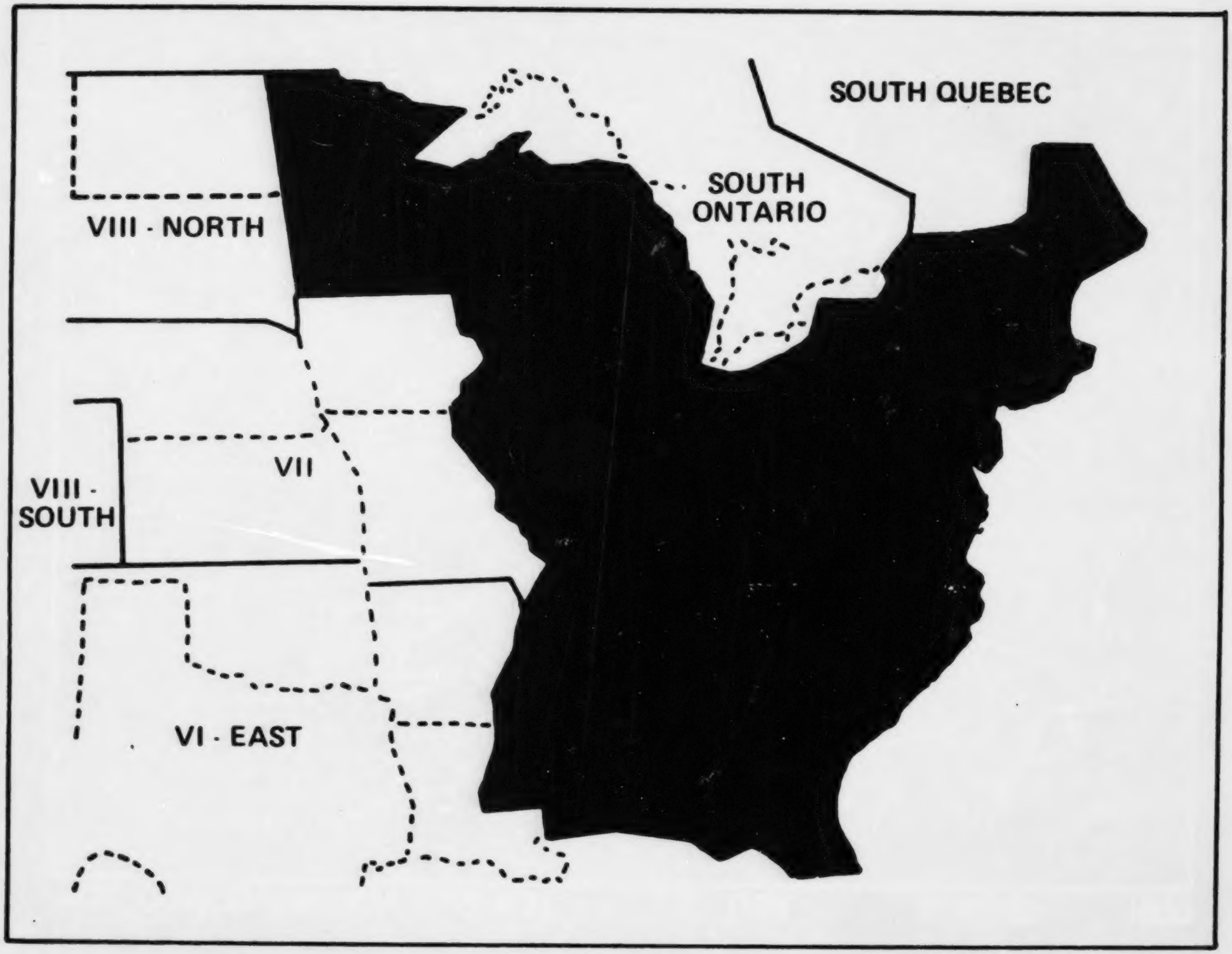


Table 1. ELEMENT VALUES USED
IN THE EURMAP APPLICATION TO EASTERN NORTH AMERICA

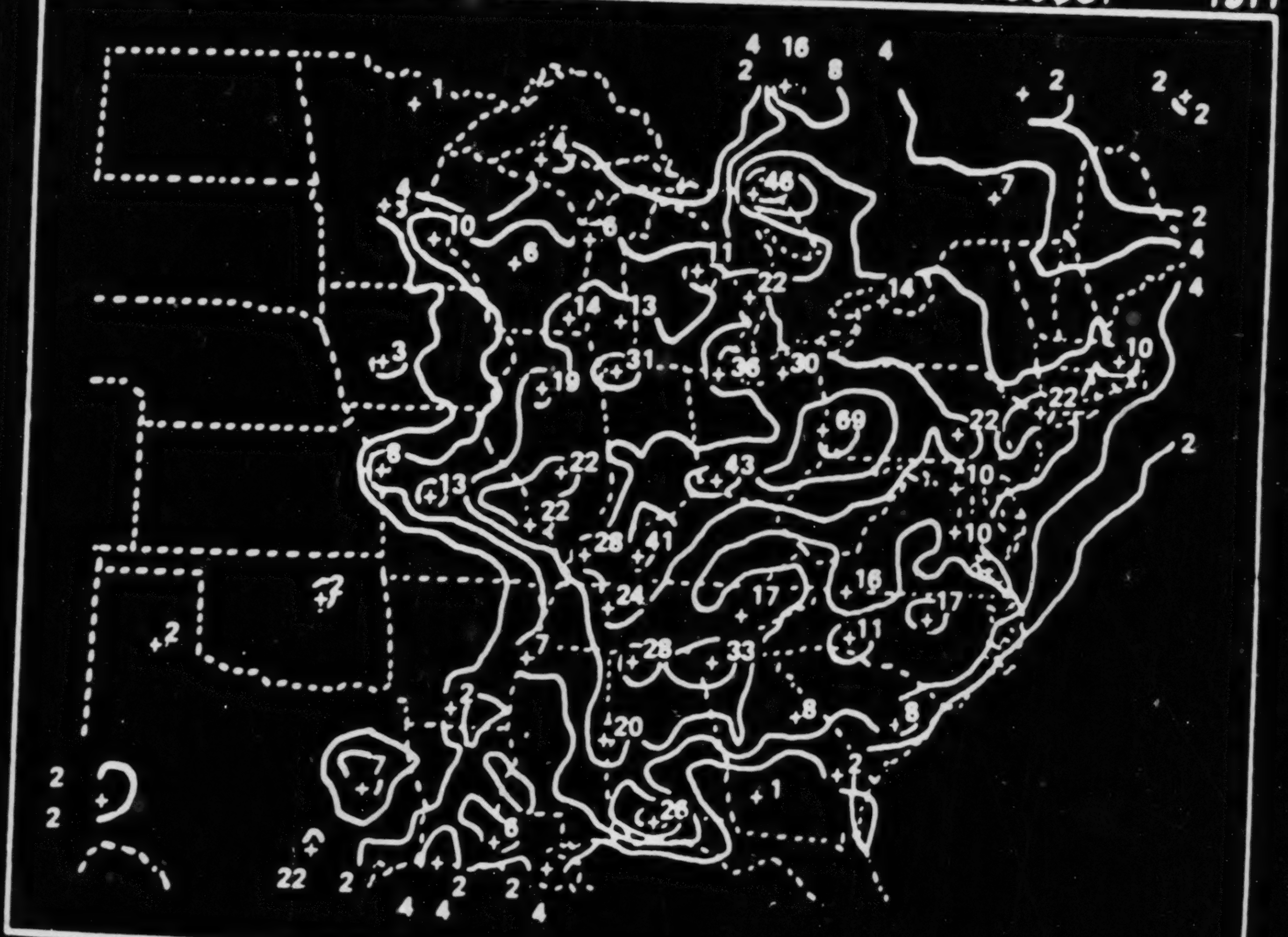
ELEMENT	VALUES
EMISSION RATE	DATA PROVIDED BY SEASON
TRANSPORT WINDSPEED (V) AND DIRECTION (θ)	DERIVED BY INTEGRATING WINDS OVER BOUNDARY LAYER
MIXING HEIGHT (km) $h = h_o + \zeta\Lambda$*	 $h_o = 1.3$ $\zeta = -0.15$
SO_2 DEPOSITION RATES (hr^{-1}) DRY WET	 0.037 0.28R÷
$SO_4^=$ DEPOSITION RATES (hr^{-1}) DRY WET	 0.007 0.07R÷
$SO_2/SO_4^=$ TRANSFORMATION (hr^{-1})	0.01

*Λ = +1 IN WINTER, -1 IN SUMMER, AND 0 IN SPRING AND FALL.

÷R IS THE PRECIPITATION RATE IN mm/hr^{-1}.


SOUTH QUEBEC
SOUTH ONTARIO
VIII - NORTH
VII
VIII - SOUTH
VI - EAST

SO2 CONCENTRATION (μG/M3) E. USA AUGUST 1977


4
2
16
8
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46
7
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2
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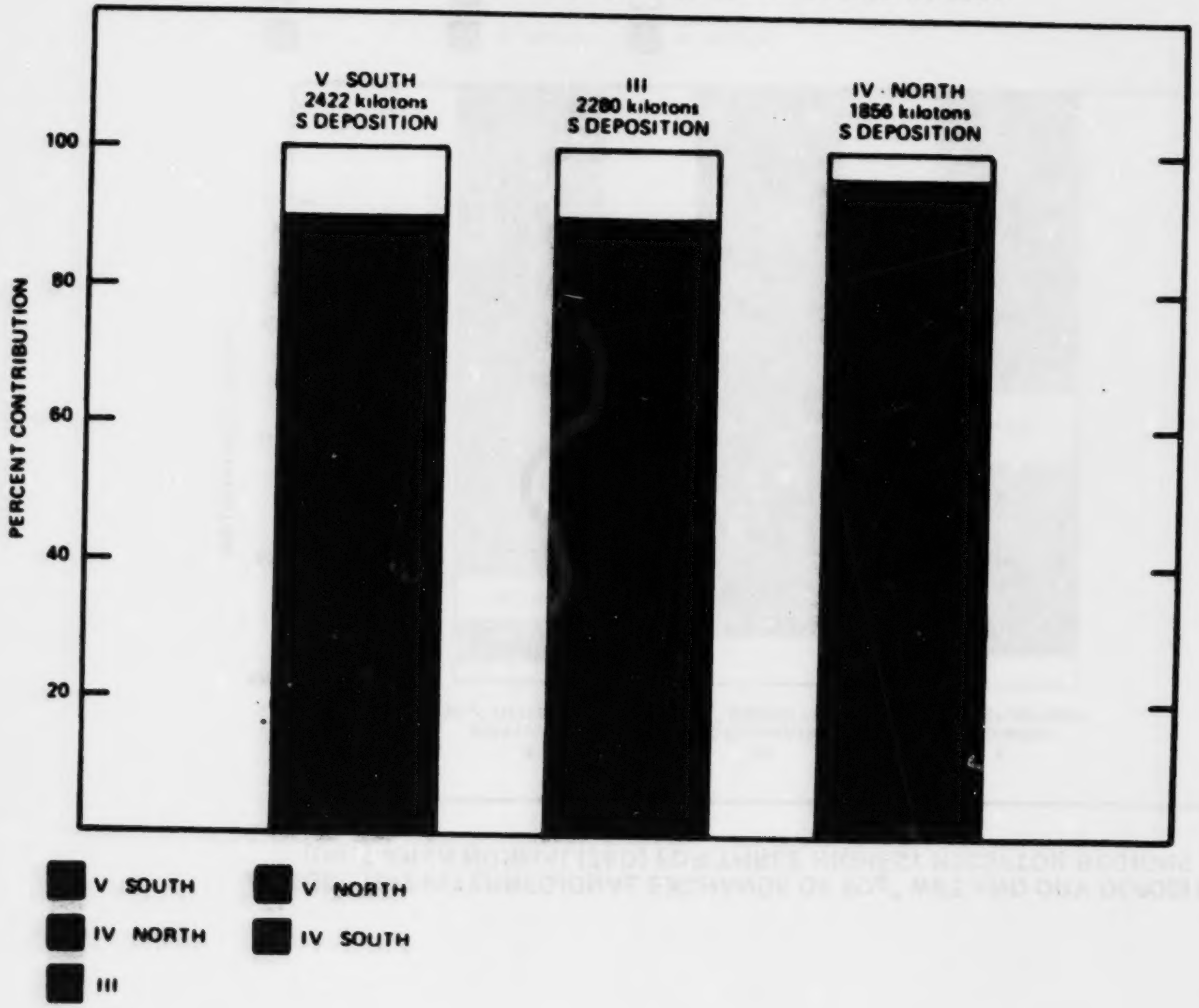
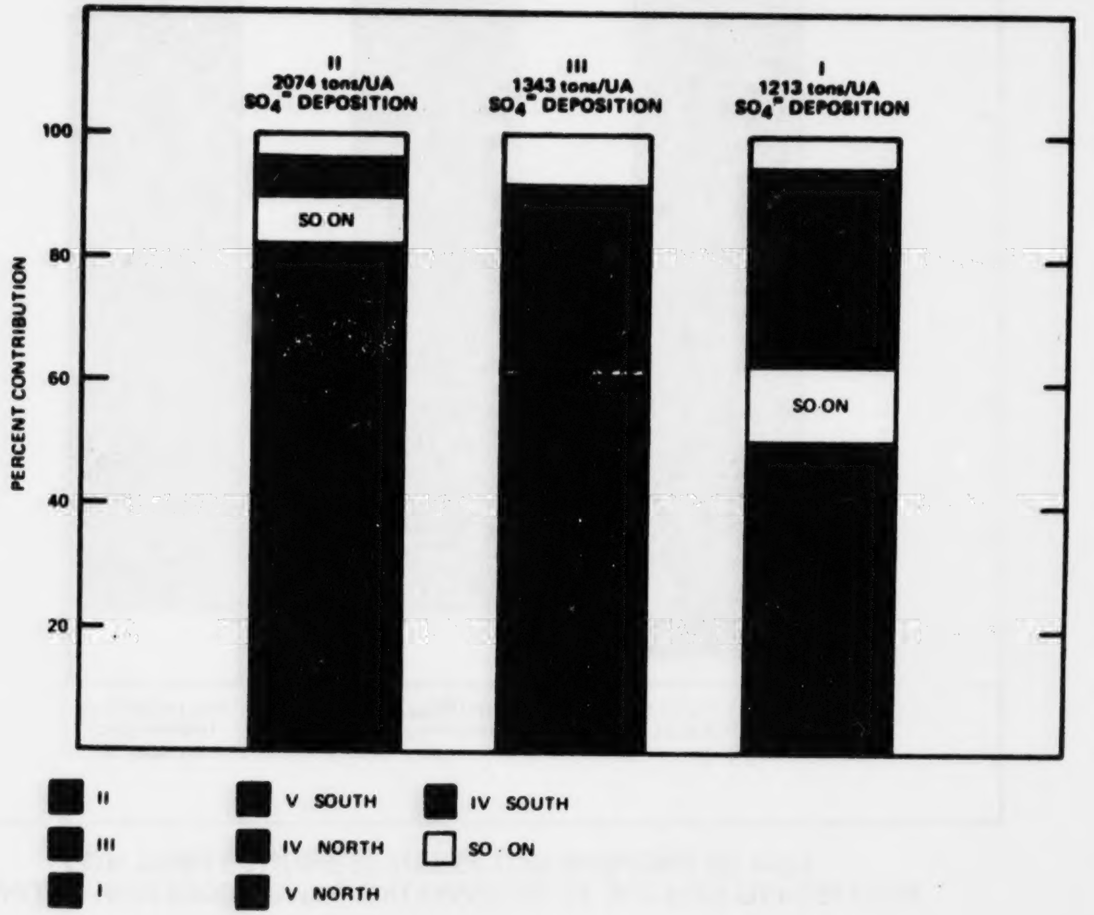
1
26
6
22
2
4
4
2
2
4

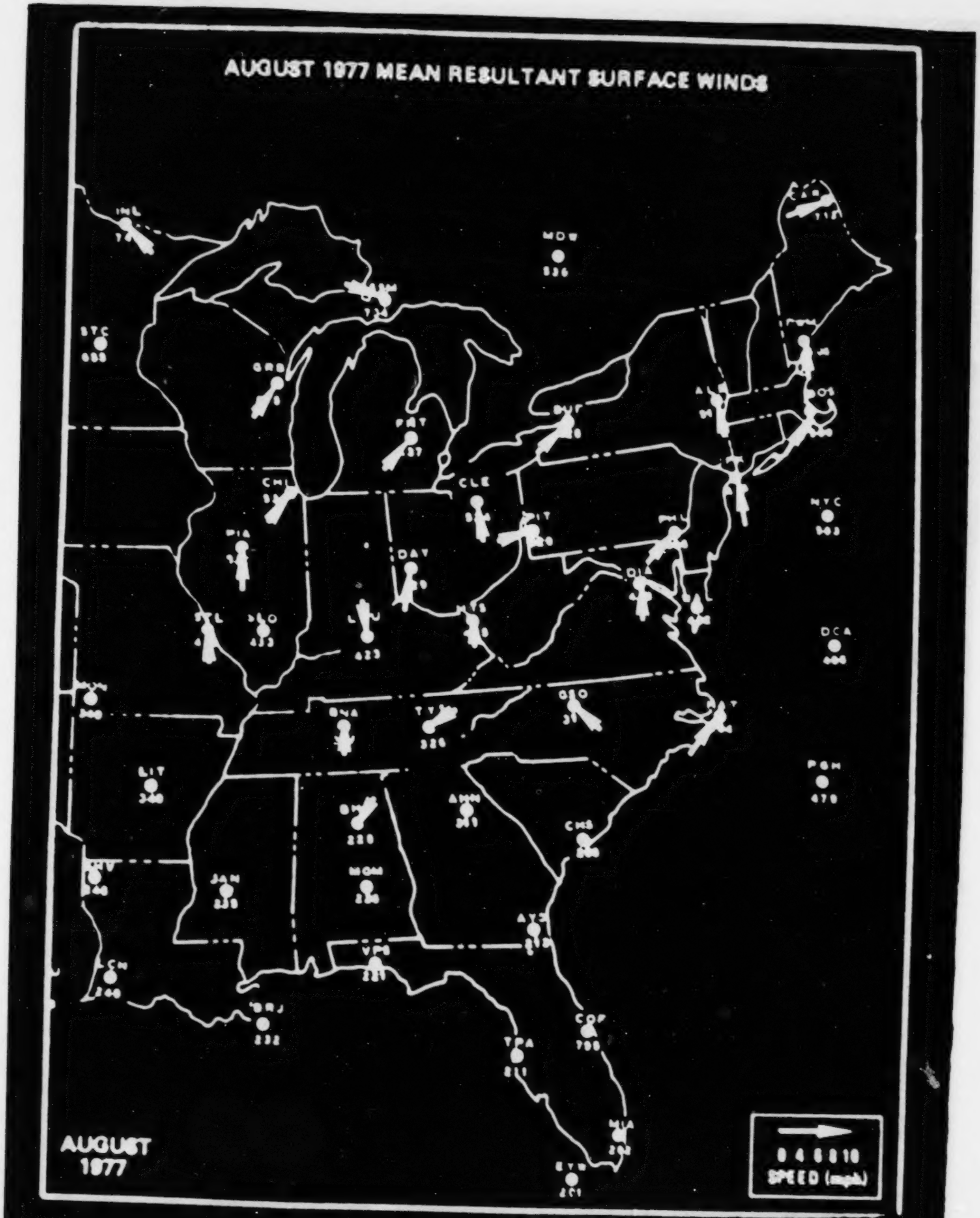
LOCAL MAXIMUM VALUES SHOWN APPLY AT POINTS MARKED BY PLUS SIGNS

ANNUAL INTERREGIONAL EXCHANGES OF SULFUR DEPOSITION FOR THREE HIGHEST RECEPTOR REGIONS IN 1977



AUGUST 1977 INTERREGIONAL EXCHANGE OF $SO_4^=$ WET AND DRY DEPOSITION (UNIT AREA NORMALIZED) FOR THREE HIGHEST RECEPTOR REGIONS




AUGUST 1977 MEAN RESULTANT SURFACE WINDS
INL
MDW
326
STC
GRB
FNT
CHI
CLE
BUF
PWM
BOS
NYC
PIA
DAY
PIT
PHL
STL
423
423
DCA
BNA
TYS
326
GSO
LIT
PGM
470
BHM
220
AHN
CHS
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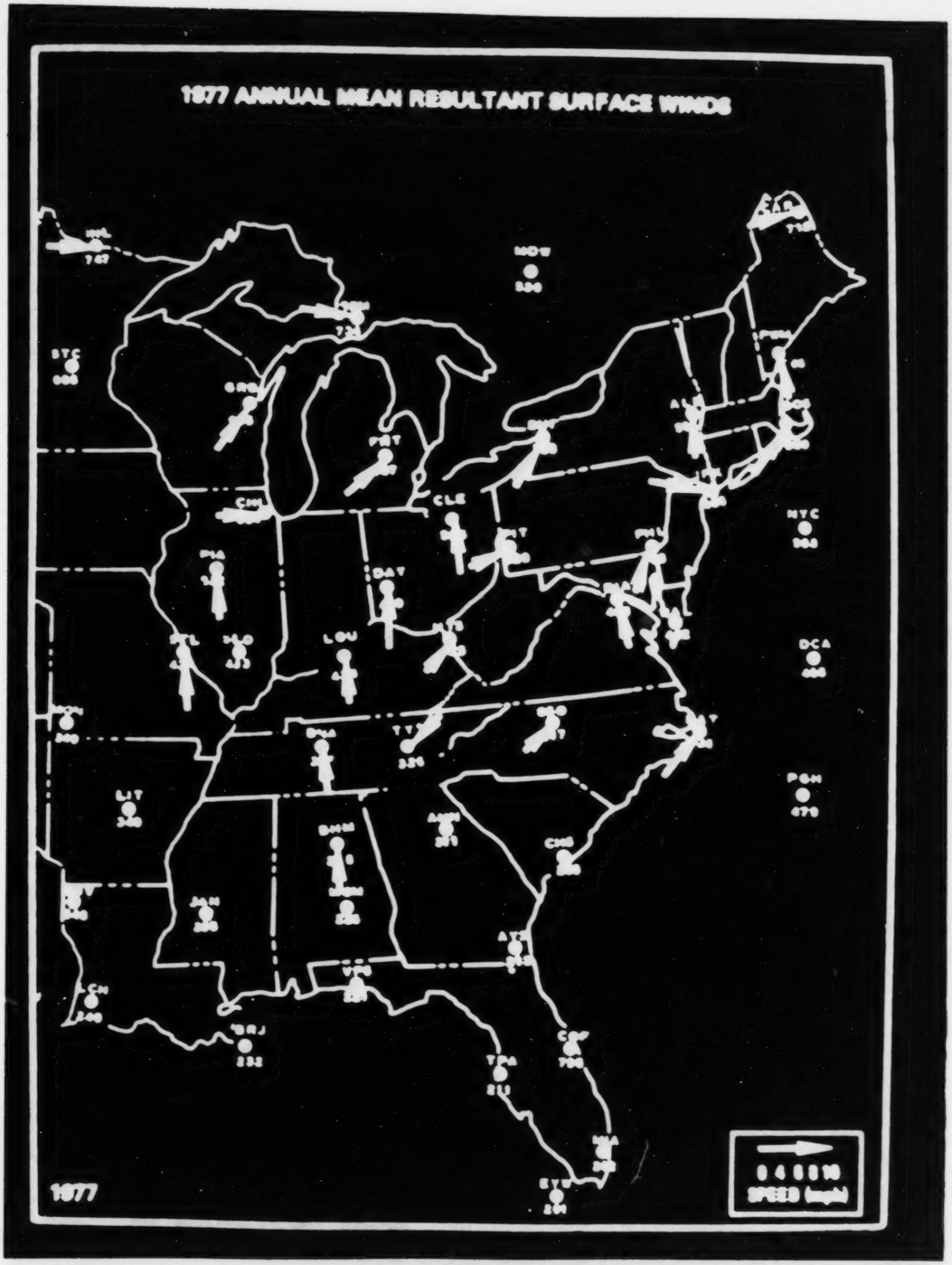
1977 ANNUAL MEAN RESULTANT SURFACE WINDS

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Mr. Gage: Well so far, we have been concentrating on what goes up into the atmosphere; what happens to that material in the atmosphere; how it comes down; and what is the effect of that material. Now we would like to take a somewhat different tact for the closing formal presentation today and that is: what we might be able to do about keeping those materials out of the atmosphere. Before I introduce the next speaker, I would like to indicate that following this next talk, we will have discussion among all the panel members who have given presentations this afternoon and the State representatives. I also would like to indicate that we will take written comments and questions from other members of the audience and we are serious about responding to those in the time that we have. I see that Dave Hawkins is right out here in the front row and if you would like to get a question up here, we will take them in order of the written questions received there by Dave, or Dennis Tirpak or Ken Demerjian could take them. As I collect them, I will try to work them into the series of questions which I am sure will be coming from our State respresentatives. Without any more introduction, let me introduce Dr. Steven Reznek who is the Deputy Assistant Administrator in the Office of Research and Development. Steve heads the Office of Environmental Engineering and Technology and as such has the responsibility for the pollution control development activities within the Environmental Protection Agency. Steve will be talking about the technology and cost of controls associated with controlling the acid precipitation precursors, the nitrogen oxides, and the sulfur oxides. Steve.

Dr. Steven Reznek: Thanks, Steve. (Slide 1) Many of the other papers were about subjects that nobody in the audience knows much about, like satellites. I am going to start out by violating one of the rules of public speaking, I am going to talk about what I am not going to talk about first. It is possible to control the national emission inventory or the regional emission inventory of sulfur and nitrogen oxides through nonstructural approaches. (Slide 2) These options can be extremely attractive because they do not require any new capitol investment or capitol construction. They would require changing the electricity capacity dispatch among the utilities that operate in the Eastern United States. Such approaches raise a series of very complicated and confusing economic and institutional questions. We are going to be looking at such solutions, what can be achieved, and what some of the problems would be, but we have not yet moved very far in that analysis. Therefore, as I started out by saying, that is one of the things I am not going to talk about.

What I am going to talk about is some of the technology solutions that exist today for solving the problem. Slide 3 summarizes some of the things I am going to cover. We differentiate the technologies as those applicable to NO_x reduction and sulfur oxide reduction. We have also listed them in terms of precombustion modification (what you can do to coal to make it a cleaner fuel); changes in the combustion process itself (things you can do today to make that process cleaner); and finally, the treatment of flue gas after combustion to remove sulfur oxide.

I want to take one minute to talk about the combustion processes used today. Approximately 60% of the NO_x emitted by utility boilers comes from so-called wall fired units. These are units where the actual coal-fired burners are in the long faces of the boiler. Forty percent of the NO_x from existing facilities today come from so-called tangential fired boilers, the coal burner is in the corner. One of the things you can do is to use so-called modern burning designs. This means replacing the burners. That is only applicable on the wall fired facilities. The modern burners could not be used in the tangential fired capacity. There are things that you can do to control the combustion process in the tangential fired burner. We will return to this point.

First thing I want to talk about is physical coal cleaning. Slide 4 is a schematic of a coal cleaning process. The coal comes into a crusher, it is ground up and goes into a grate, and then it is introduced into a liquid bath, and the schematic shows what happens. The ash material is heavier than the coal. The coal floats on the surface of the liquid and is removed. The ash material and, in particular, the sulfur containing pyrite sinks to the bottom and is removed.

We have a number of handouts in the material, including an article which was prepared by the Electric Power Research Institute, discussing the advantages of coal cleaning. Over half of the coal mined in the United States today is cleaned in a process similar to this. Those processes are not optimized for sulfur removal, however. There is another article by Jim Kilgroe summarizing our position on the cleanability of various coals in the United States.

You cannot completely separate the coal floating on top and the ash material that sinks to the bottom. All coal cleaning processes require or imply a loss of coal in that bottom residue. For highly cleanable coals that residue can be kept to about 5 to 15% of the carbon content.

Slide 5 is a schematic of the technology for which I guess EPA is most famous, that is, flue gas desulfurization scrubbers. In flue gas desulfurization, a slurry of an alkaline material either lime or limestone usually is introduced into the chambers you saw, and the flue gas post-combustion is also blown up through that chamber. The sulfur oxides in the flue gas reacts with the alkali lime or limestone and is absorbed--the gas goes out and is discharged.

We show two versions of flue gas desulfurization, the so-called spray dryer version is applicable to lower sulfur coals. In that version the heat of the flue gas is used to completely evaporate the slurry. What comes out is a dry powder. The spray dryers that are being built, and have been built at pilot scale, are using lime as the reactor rather than limestone.

In the more traditional kind of scrubbing--the wet scrubbing--the heat of the flue gas is not nearly sufficient to evaporate the water. The water with the reacted limestone is discharged. The solid matter is separated--that is the stuff called sludge. There is a very large handout in some of our materials discussing the subject of sludge.

The capitol investment in the dry or spray drying technology is considerably less than the capitol investment in the wet process, however, the operating expenses are considerably higher. First, you have to use lime rather than limestone as a reactant. Second, the reactant's alkali is not fully utilized, so you will have to use more of it than theoretically the minimal amount for the sulfur. What all that means is that for low sulfur coal the technology of choice will be the spray dryer. For high sulfur coal the wet or conventional flue gas desulfurization will be the most economical. It appears that the break-even point is between 2 and 3% sulfur coal.

Slide 6 is a schematic of a modern dual register burner. The pulverized coal enters down the center tube and air is introduced to the flame chamber from two separate registers, an inner air supply and an outer air supply. There is not enough air in the first tube to complete the combustion so the flame forms in two zones. The first part is the reducing or fuel rich zone where much of the coal is partially oxidized. The outer air supply has enough air to complete the combustion. That staging process prevents the oxidation of the fuel bound nitrogen. Fuel bound nitrogen becomes N_2 rather than being oxidized to NO, the nitrogen oxide.

Slide 7, this technology--over-fired air--is applicable to the corner fired or tangential fired boilers that are in place now. Here you want to stage the addition of air to complete combustion, however, in this case you add the secondary air well away from the burners at the top of the boiler. It is possible to achieve close to the same results in terms of reducing the formation of NO.

Slide 8 is a summary chart of the cost of sulfur reduction technology. The two middle bars are low sulfur coal and the bars on the extreme left and right are high sulfur coal. The first technology, PCC is physical coal cleaning.

We are able to remove between 20 and 40% of the sulfur. Assuming you are trying to recover something like 90 to 95% of the energy value, your ability to remove sulfur is very dependent on the individual coal characteristics.

Northern Appalachian coal is the most easily cleaned coal. As you move into the central province coals--Ohio, Indiana, and Illinois coals--the sulfur becomes more difficult to remove. For the two low sulfur coal cases, we have costed out the spray drying technology and the conventional flue gas desulfurization technology for 70% removal for low sulfur coals. We have also developed the costs for treatment of high sulfur coals, taking conventional technology at 90% removal. At the bottom of the slide, we show the cost per ton of sulfur removed. You will notice that the physical coal cleaning and the flue gas desulfurization on the high sulfur coal are coming out about the same cost. Another document in the handout has looked at 11 different utility boilers that actually exist, and at the cost savings that can be achieved by combining front-end coal cleaning with back-end flue gas desulfurization. Those designs are for 1.2 pounds per million Btu emission requirements.

Slide 9 is the same kind of information for NO_x removal using the present currently available control technology. In both the modern burner design on the wall-fired units and the stage combustion or over-fired air on the tangential fired units you can reduce their present emissions by about 30%. The cost to achieve that reduction is quite low compared to the sulfur costs.

Slide 10 is a summary table of costs. The first column and the last column are the numbers you have seen on the previous two graphs. Let me concentrate on the middle two columns, they are the cost per unit of electricity generated. Look at the high sulfur coal case. Physical coal cleaning, the capitol cost, is in the range of $35. per kilowatt of electric generating capacity that you would design that coal cleaning plant to supply. In other words, if you were designing for a 1,000 megawatt plant, you would multiply that 34 by one million and get 34 million dollars. The conventional flue gas desulfurization cost is $175. per kilowatt of capacity. These cost are based on amortization over a 15 year lifetime, assuming a retrofit, and the load factor is 50%. We are assuming those plants will continue to operate at 50% of the time over the next 15 years. That 50% number goes into the annualized cost in terms of dollars per kilowatt hour of power produced. Those numbers are reflected in the 2.7 mills per kilowatt hour for the physical coal cleaning and the 9.1 mills per kilowatt hour for the flue gas desulfurization.

I have included in the handout five summary data tables, but I am only going to look at one of them. I put in a summary of the performance, the applicability, the advantages, and the disadvantages for each of the five technologies that I have talked about. Let me just run through the one for physical coal cleaning. (Slide 11) The performance has a range of 20 to 40% reduction, it is applicable on the Eastern Appalachian coal and some of the Midwestern coals, but as you go to central province coals, the applicability goes way down. Advantages are lower cost, often lower transportation cost, the EPRI paper discusses the fact that the Btu content of the clean coal can be significantly higher than the Btu content of the raw coal. Much of the solid waste--sulfur, pyrite, and ash--that would be generated at the coal cleaning plant are at the mine where disposal problems are easier to resolve. This is one of the few ways of getting a cleaner fuel to small boilers, boilers that could not afford flue gas desulfurization technology.

Disadvantages--it is not applicable to all coals, only a 20 to 50 percent reduction can be achieved and there is an energy penalty. There is a coal loss penalty of 5 to 15%. I have such a summary sheet in the handout for each of the other four. I want to turn lastly to some of the things that are on the horizon.

We do support an R&D program in control technology. (Slide 12) We are going to demonstrate a three-stage combustion burner. The first one, the low NO_x burner would be applicable to the wall-fired unit and the so-called rich fire ball would be applicable to the corner-fired boilers. One of the problems that you have to demonstrate that you can avoid is corrosion on the wall faces of the boilers. Therefore, these demonstrations have to be fairly long-term, at least 18 months. We hope to have those completed by 1983.

The summary paper in your handout talks about what we are hoping to achieve--i.e., a 70 to 80% reduction in NO_x emissions. These technologies hopefully will be usable on the existing boilers. Another project that we hope to have completed this year is the creation of coal limestone pellets. This fuel would burn with considerably reduced SO_2 emissions. This fuel is not applicable to utility boilers. It is applicable to small, stoker-fired boilers. We are hoping that demonstration will be completed this year.

Another demonstration that we are hoping to complete this year is our buffered limestone scrubbing, so called adipic acid additive. That is a buffering agent to the limestone slurry. It allows very enhanced control of the chemistry of the desulfurization reaction. One way to look at the effectiveness of this technology is that for the same design, it would increase removal efficiencies from 90 to 95%. The other way to look at it is if you design for 90% removal, you would lower your overall cost by about 7% using adipic acid buffering.

Finally, let me talk about the last technology. We are extremely excited about this. We are going to try to combine our low NO_x burners with a powdered limestone addition to the coal. This is a very cheap technology. We know from pilot data that it will force the sulfur in the coal into the form of a calcium sulfate in the particulate. Some Western coals burn this way right now. Instead of coming off as SO_2, the coal's sulfur decreases calcium sulfide in particulate. With the new technology, you will be able to catch the sulfur without a scrubber, using only conventional particulate control. This is now a gleam in our eye, based on some pilot data, but we are hoping to get to a demonstation by 1985. Thanks, Steve.

Dr. Gage: Thank you, Steve. Amazing we are within five minutes, allowing for two academics, one member from the private sector, and four bureaucrats. I don't think that is too bad. Now, we would like to open the floor for discussion, and I would like to ask Dr. Galloway and Dr. Cowling to come up and join us during the question period. Please identify yourself and your State.

Emissions Control
Technology and Costs

Steve R. Reznek
April 8, 1980

Nonstructural Approaches

Least Emissions Dispatching

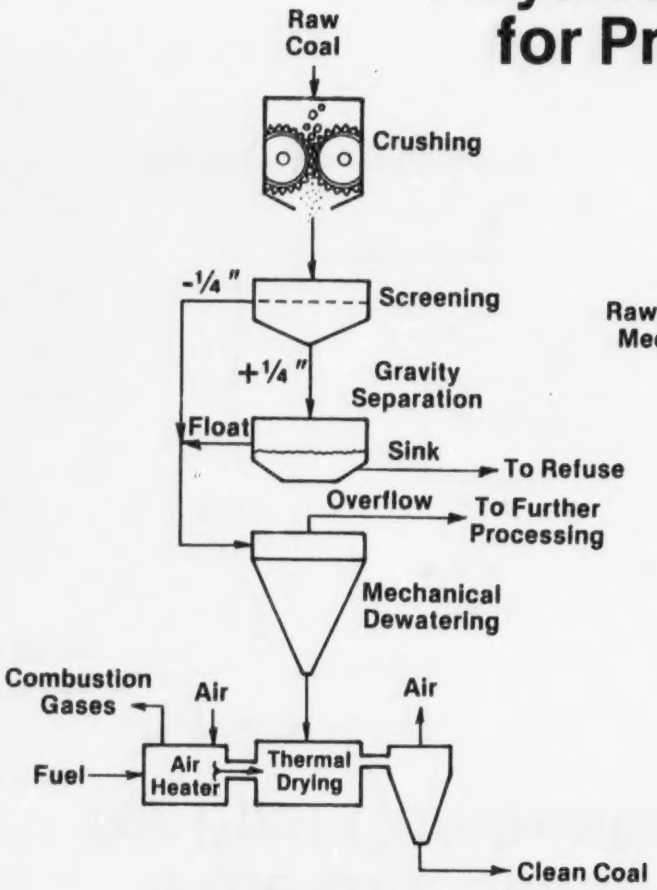
- Institutional and Economic Questions

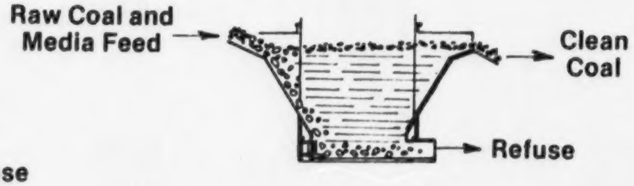
Plant Retirement Schedules

Summary of Existing and Near Term Control Technology

	SO_x Reduction		NO_x Reduction	
Classification	**Technology**	**Applicability**	**Technology**	**Applicability**
Precombustion	Physical Coal Cleaning (PCC)	High Sulfur Coals	— —	— —
Combustion	— —	— —	Modern Burner Design (MBD)	Wall-Fired Boilers
			Staged Combustion (SC)	Boilers Less than 15 Years Old
Post Combustion	Flue Gas Desulfurization (FGD)		— —	— —
	•Conventional FGD	High Sulfur Coal		
	•Spray Drying	Low Sulfur Coal		

Physical Coal Cleaning (PCC) for Precombustion Sulfur Reduction

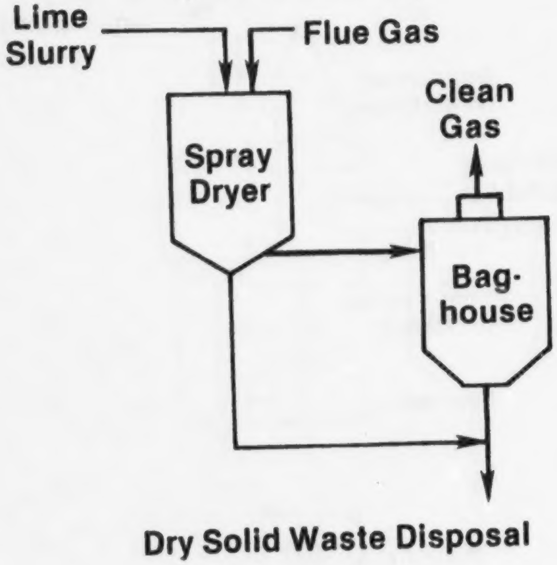

Raw Coal
Crushing
Screening
-¼"
+¼"
Gravity Separation
Float
Sink
To Refuse
Overflow
To Further Processing
Mechanical Dewatering
Combustion Gases
Air
Air
Fuel
Air Heater
Thermal Drying
Clean Coal


Raw Coal and Media Feed
Clean Coal
Refuse

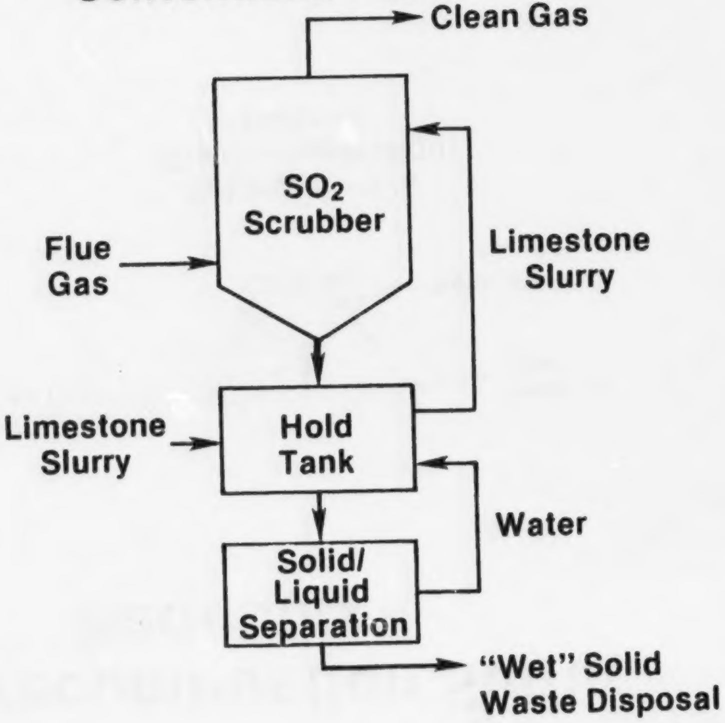
Enlargement of Gravity Separation Process

Flue Gas Desulfurization (FGD) for Post Combustion SO_x Reduction

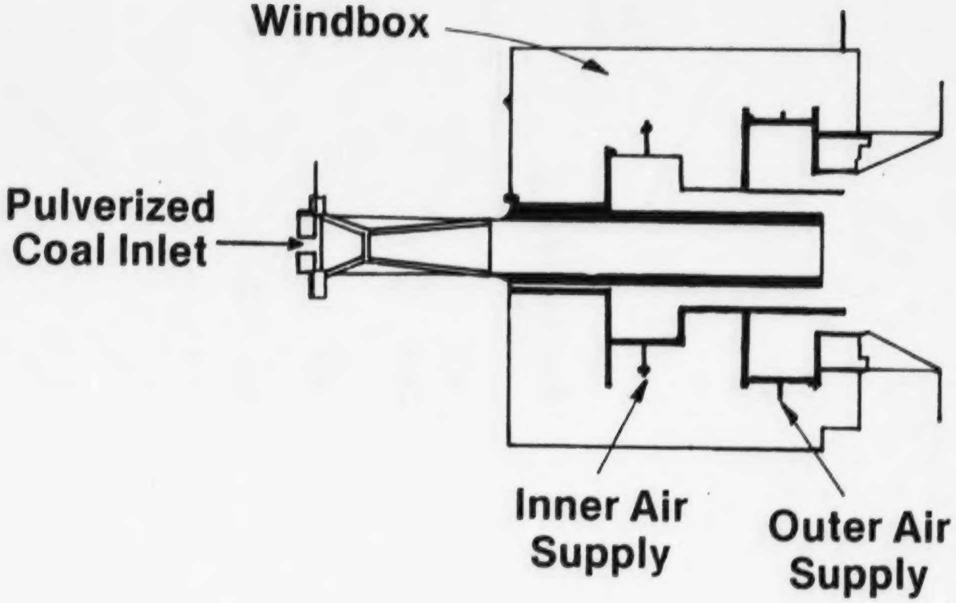
Dry Scrubbing


Lime Slurry
Flue Gas
Spray Dryer
Clean Gas
Bag-house
Dry Solid Waste Disposal

Conventional FGD

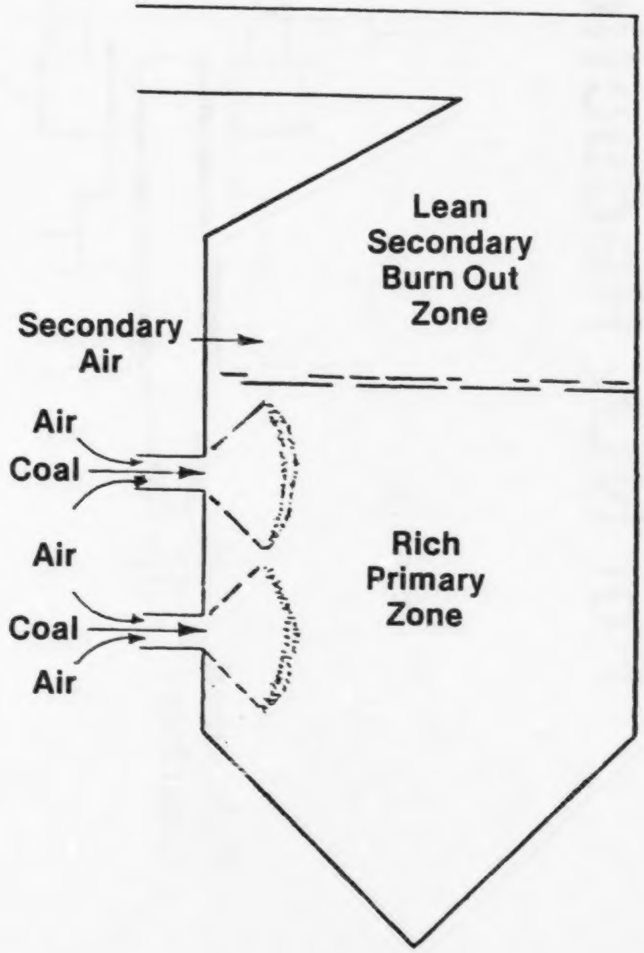

Clean Gas
SO_2 Scrubber
Flue Gas
Limestone Slurry
Hold Tank
Limestone Slurry
Water
Solid/ Liquid Separation
"Wet" Solid Waste Disposal

Modern Burner Design (MBD) For NO_x Reduction


Windbox
Pulverized Coal Inlet
Inner Air Supply
Outer Air Supply

Staged Combustion

(NO_x Combustion Technology)



Lean
Secondary
Burn Out
Zone

Secondary
Air

Air
Coal

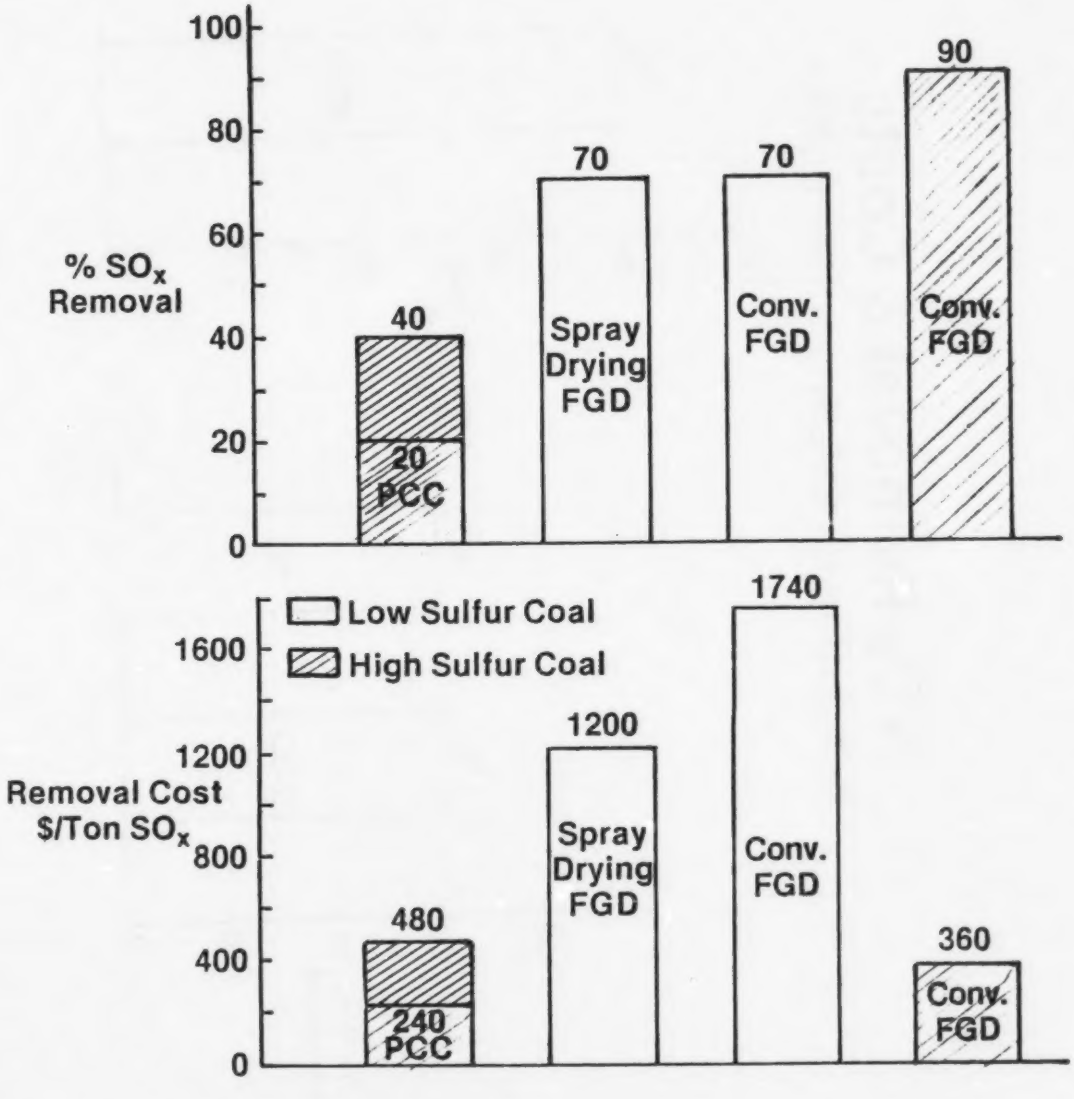
Air
Coal
Air

Rich
Primary
Zone

Slide 7

SO_x Removal & Costs

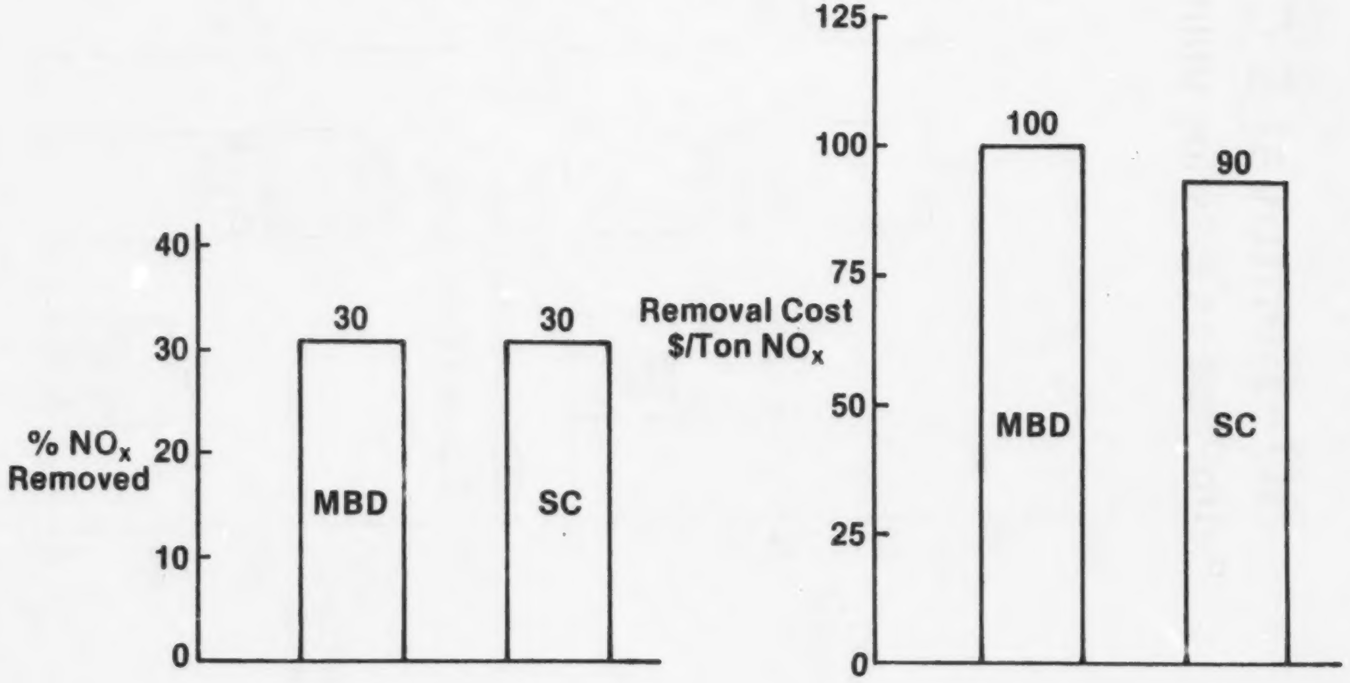
Retrofitted on Existing Utility Boilers



Slide 8

NO_x Removal & Costs

Retrofitted on Existing Utility Boilers



Control Technology Cost
Retrofitted on Existing Boilers

	Percent Removal	Capital, $/KW	Annual Cost, mills/kwh	$/Ton SO_x or NO_x Removed
SO_x Control				
Low Sulfur Coal				
• Conventional FGD	70	120	7.0	1740
• Dry Scrubbing FGD	70	85	4.7	1200
High Sulfur Coal				
• PCC	40	34	2.7	240
• Conventional FGD	90	175	9.1	360
NO_x Control				
• Modern Burner Design	30	4.2	0.11	100
• Staged Combustion	30	3.0	0.10	90

SO_x Control Technology
Physical Coal Cleaning (PCC)

Performance

- 20-40% Reduction

Applicability

- Appalachian and Mid-Western Coal

Advantages

- Low Cost
- Lower Transportation Cost
- Solid Waste at Mine
- Small Boilers

Disadvantages

- Not Applicable to All Coals
- Low to Moderate Reduction
- 5-15% Coal Loss

Will Brown from New Hampshire, Acting Chairman of our Water Pollution Agency. I would like to commend our guest from Canada for a forthright and down-to-earth statement. I would hope that it is not just because he is a long way from home and feels freer to speak up. I would hope that many of his American counterparts who go to Ottawa would do an equally good job. I guess what I am saying indirectly is that I for one around the table here am not technicial. I recognize the importance of the research work in which you are engaged, but I get a little impatient to come to grips with what we are going to do about it, especially in political terms. I guess that is more of a comment than it is a question for any one individual; unless it might be fair to ask Ray Robinson since he alluded to the work that is being done toward an international treaty, whether he would care to make any comments as to how that is proceeding, whether there is anything that individual States can do that might be helpful.

Mr. Robinson: Thank you very much for your comments. I do not think my comments were a function of distance from my superiors. Quite the contrary. In our system, it is extremely important that the really exciting news be given out by the boss rather than by someone like me. That is to say, I really feel that we are going to be able to say even firmer things. We are very, very determined to bring SO_2 emissions down in Canada, and it is a little easier for us because we have some rather larger targets in the sense that they are all concentrated in one or two places. Our talks are already underway toward that end, so it was not just rhetoric. We are, in fact, going to bring those SO_2 emissions down. I think, to put it very squarely, we now realize that some things are happening to our environment that are widespread and serious. The only argument is how quickly it is happening and precisely what effects and the range of those effects. There is no argument about whether something adverse, or of a serious nature, or widespread is occurring. From that standpoint it has not been too difficult for us to develop the political consensus to move. I fully recognize that this is more difficult for yourselves because you have a much more varied situation in the United States in terms of the impact. Having said that, that raises the question which you raised, which is the question of the agreement between the two countries. We have before us now, a proposal by the United States to set up a structure that is analogous to the one that preceeded the Great Lakes Agreement. Some of you are familiar with that, indeed some of the States here are very familiar with that agreement, and will know that prior to negotiating the original agreement back in 1972, there was set up between the two countries a task force with ten subcommittees to look at all the component elements that should go into the agreement, to examine what the IJC had brought forward, and then recommend to the two governments what ought to go into the agreement. That was the procedure that was followed. It was very effective, and it led to an effective agreeement and a subsequent renewed agreement as you know in 1978. To those States here today that are located around the Great Lakes, I think you will agree that we are certainly moving in the right direction in the Great Lakes area because there has been a real improvement. The proposal now is that we put in effect a similar structure for the purpose of bringing into reality an air quality agreement. Obviously, as a general concept, we welcome that proposal. We are now examining the detailed description of the task of each committee to see if we agree with that. If we do, no doubt, we will get it on the road. Thank you.

Dr. Gage: We have not waited for a formal agreement to be signed either. We have had joint research groups working for some months now and they are preparing a report, to be dated, I believe, October 1, to advance our understanding of the transboundary problems. Of course, all of tomorrow's session will be devoted to the thrust of your initial question, Mr. Brown, pointing towards steps we can take here in the United States to begin to discuss what other problems we are going to run into in both the political, technological, and economic areas. Other comments or questions?

Carl Beard from West Virginia. Dr. Robinson, I heard you say there were measurable changes in soil chemistry that your people have looked into and researched. I thought I heard you say it is changing rapidly. Could you enlighten us a little further on that? Who is doing the work for instance?

Dr. Robinson: I am sorry, sir, if I misled you on that point. What I was saying and, in fact, what I skipped over in my address because I felt I was repeating some of the earlier statements, was basically that while there is disagreement, or more precisely a lack of conclusive evidence on the rate at which changes are occurring, what we are finding is that in the aquatic ecosystems there are appearing a number of components that were previously in the soil. Obviously, these are coming out of the soils, and the rate at which they are coming out does seem to be erratic. There is some confusion over the speed at which the phenomenon is occurring. What we really get down to is not so much the argument about whether there is a change in soil chemistry, there must be. The substances are coming out of the soil in a manner different than would occur in a normal sense. Therefore, there must be changes occurring in the soil chemistry. The difficulty has been in determining what this means. There is the argument about the positive effects in certain particular types of soil. We come back then to the particular kind of soil. If you look at the different kinds of soil, again you draw a quite different conclusion as to the implications. From that perspective we are no further ahead than anybody else. Our particular concern, naturally, necessarily, is over the impact on our forest because of the size of our forest industry, and also because located as we are in a northern area, our growth cycle is slower than in southern areas. Therefore, any marginal impact could have quite serious implications for us. We have a marginal economic productivity in some areas. That being the case we have been able to demonstrate in internal studies and in lab work definite reactions in vegetation to changes in acidity in soil chemistry. We have not been able, to borrow a term from the atmospheric chemists, to ground test these truths in terms of the reality out in the field. The reason for that is one that anyone would readily recognize, there are so many different things which impact on the growth of trees that to be able to demonstrate over a short timeframe that what you have shown in the lab is occurring in a real life situation is certainly difficult. Our forestry scientists tell me they would be no more successful than the Swedes, who have been at it a lot longer, in trying to prove that what they have shown in labs is also occurring out in the fields. A lot of the disagreement about the impact on the forest industry comes from the fact that we cannot conclusively prove, in the field, that trees are, in fact, growing more slowly. We do not have the background; we do not have the data; we do not yet have the time to do this. We certainly can show that there are changes in soil chemistry, we can show that that appears to have adverse effects in lab settings, and we--the people who are expert in these things--can draw a number of conclusions about what it does to plants if you make certain changes in nutrient patterns--the possiblity of the uptake of nitrogen for example, this sort of adverse impact. All this can be done and put forward on a theoretical basis, but it is still questioned for the reasons I have indicated. I do not have before me the list of people doing this type of study, but I am sure that information could be obtained for you.

Dr. Gage: I might also ask Professor Cowling to respond in part to that question. Professor Cowling along with a number of other U.S. scientists was at the meeting in Norway less than a month ago. I believe the Swedes reported at that meeting some very interesting and alarming results on the effects of acid rain on certain soil horizons in southern Sweden.

Professor Cowling: Let me comment in general about what we understand. I think Dr. Robinson has characterized our general understanding very adequately. The hydrogen ion tends to displace other cations--some of which are nutrients, some of which are metals. Whether they are metals or whether they are nutrients, they are going to end up downstream. That may be groundwater, surfacewater, streams, lakes, or so on. I think it is also important to understand that certain soils would benefit from acidification. In Western Canada and the Western United States there are soils that are more alkaline than optimum for a range plant growth or for forest growth. In certain of those instances a bit of acidification could be beneficial. In most soils, acidification tends to decrease productivity, largely because of displacement of cations. A diminished cation exchange capacity means the ability of the soil chemistry simply to hold nutrients in a situation where the plants could benefit from them. There are also rather complex influences on soil microbial processes. It is very difficult to generalize about those influences because they are so variable with the type of soil and with the nature of the vegetation. I think it is also important to recognize that in this linkage between dry deposition and acid precipitation, it seems a simple solution to inject ammonia into the flue gas stream, create neutral ammonium sulfate, and get rid of the acid rain problem period. But the net effect of ammonium sulfate being deposited dry in an ecosystem would be about 1 1/2 times as acidifying in its effect on the ecosystem as would be the direct deposition of an equivalent amount of sulfate as sulfuric acid. That is due to the microbial transformations that would be induced and the uptake of ammonia from the ammonium sulfate ion. The soils are an extremely complex area for investigative work and in the opinion of most of the scientist at the Norwegian conference we believe that whereas we know about the effects in aquatic ecosystems, we would say the next most likely frontier for affects that would be significant and particularly in regions that are dependent heavily on non-cultivated soils, forest and range soils, in those regions we can find affects. That seems generally appreciated whether you are talking to an English scientist, a German scientist, a Norwegian scientist, or a Canadian or American scientist.

Dr. Gage: Thank you, Ellis. Another question.

Del Rector from Michigan: The question for Dr. Robinson is my perception that both the citizens in Canada and the Canadian officials at the Federal level have placed a very high priority on the acid rain problem, and in fact, it appears to be setting an even higher priority than they are in solving the problem of ozone which is also a long-range transport problem. First of all I would like to know whether assertion is correct and, if it is, whether you think the government is placing the proper priorities on these pollutants and what are the problems with the public health issues.

Dr. Robinson: That is quite a question. I think it is fair to say that the concern of the public over acid rain is much larger, as a generality, than the concern over ozone. That is correct, what you have just said. In a democratic society, as in your country or ours, that is reflected in the political process. Certainly, the governments of both the Provincial and Federal levels are currently giving a lot of attention to acid rain. There is no question about that at all. On Friday of this week, the new Canadian Environment Minister, Mr. John Roberts, will be meeting with his Ontario counterpart for some pretty pointed discussions about where we are going and we hope to be moving pretty smartly toward real control measures, not just theorizing about it but really moving. That is a reflection of a political need as well as an environmental need which is why I talked about a political imperative when I gave my address. There is no question they are responding to that. In the matter of ozone, I think there are two factors to consider here. It is certainly true that ozone is a part of the long-range transport problem and it is certainly true that in Southern Ontario we are getting levels that are beyond what we call our objectives and you call your standards. There is no question about that. It is also the case that a good portion of the ozone that we are receiving in Southern Ontario does appear to be coming from beyond our southern border and I guess there is a limit to what we can actually do about that. You might say well why don't you build it into the discussions. I guess it is a matter of developing sufficient detail to do that. It also is a matter of looking realistically at what is being done and what more could be done. Again, taking the field of car emissions, for example, automotive emissions which are seen as major precursors to ozone creation, there I think it is fair to say that the U.S. has been world leaders in controlling auto emissions. I would personally like to see my own country do rather more in this regard but the question really arises: What more than you in the U.S. do? There are certain other things that can also be done but I think realistically we have to look at what you might call the controllability of the problem, as well as the impact of the problem. In the area of acid rain the potential for contolling the sources is enormous. Whether they get controlled is another question but the potential for control is tremendous. The potential for control over and above what is being done now for the ozone problem is much less. You can get a handle on some of it through the same sort of controls you would have for acid rain. That is another question. If you had effective control on the acid-causing pollutants or the precursors, you would also get a better handle, obviously, on ozone since in some cases it is the same precursors. So from that perspective, I see as a practical matter the thrust to deal with acid rain as having some benefit in the ozone matter and as a practical political matter in Canada, there is no question that acid rain is the front page concern. So from both of those perspectives, I am not too upset about that situation.

Dr. Gage: Yes, Bob please.

Bob Flacke, Commissioner of the Environmental Agency from the State of New York: For Dr. Cowling and Ray Robinson. Is there enough evidence available today in the basic academic and scientific community to indicate that some sort of source control is a necessary prelude to the variation of problems at hand?

Dr. Gage: Ellis, do you want to take a crack at that first?

Dr. Cowling: I think we need to distinguish the extent of the scientific evidence of effects on the aquatic ecosystems from the extent of the evidence on terrestrial. We know that there are effects in aquatic ecosystems and I think we know enough to realize that if we work at diminished emissions we can prolong the useful life of the lake if I may say it that way. I think we could prolong the time period over which this titration that I showed in that one draft would occur and there may be other methods by which we could come to deal in a more effective way with the deleterious effects in time. I believe we know enough to have confidence that if we diminished emissions we would increase the longevity of our fish populations in lakes and I would certainly think that that should be under very serious discussion as a matter of regulatory policy.

Dr. Robinson: Bob, if I could speak quite bluntly to that question. I explained in my address, but I did not bring along with me slides that would have shown it more graphically, that a very large portion of eastern Canada is poorly buffered which simply means that the lakes and streams in that very large portion--and we are talking about probably something in the order of three quarters of a million square miles or something of that sort, maybe more--are, over time, bound to take on the same acidity as the rainfall, simply because the buffering capacity is either nonexistent or is rapidly exhausted. The question at issue is how long will it take for many of those lake systems to reach the level of 5 pH which seems to be the magic level at which fish life starts to show serious problems. In fact, in the long term, the fish will not survive at pH below that level for the most part. Given the fact that the rain falling on these lakes is below 5 pH, significantly below in some cases, it is just a matter of time before that occurs. How much time? Well, the answer to that depends on the size of the lake, the quantity of water in it obviously, and the precise location of the lake in terms of the amount of acidity in the rainfall. Therefore, if the lake is further to the south, in Canada, there is a greater chance of it going acid that much more quickly. Already we have lost about 150 lakes which have reached acid levels of 5 or below and into which have also been released from the surrounding soils sufficient heavy metals which are toxic to fish. As a consequence, our efforts to lime some of these lakes to restore the acidity levels and reestablish the fish populations have failed. The fish were not able to cope with the change in water chemistry. That is very worrisome because it suggests that notwithstanding the obvious difficulty of reversing the pattern and getting the lakes to pH levels that are acceptable through a natural process, you may not be able to reverse the effect, which is extremely worrying. That is why I use the phrase in my address "time sensitive." That suggests to us that we really do have a clock ticking away and the more dramatic efforts in Canada to popularize the issue have shown clocks with so many lakes per minute disappearing. Nonetheless, statistically there is a certain element of truth if you look at it over the long term and we are probably talking twenty years for a good portion of these lakes. It may be thirty years, it may be less than twenty, and it is that kind of precision that we do not yet have. Here I will speak very bluntly, if I look at the projections for NO_x and SO_2 emissions in Eastern North America over the next twenty years, they all show substantial increases. That means the acidity of the rain is going to get greater, there will be more acid rain, rather than less. It means it will spread over a larger geographical area and that the pH values will be lower in the sensitive areas--the very pattern we have seen shown to us today. On the basis of present levels of acid rain, we are projecting tens of thousands maybe even hundreds of thousands of lakes being affected in the next twenty to thirty years. What then are we to expect if in fact there are increases in emissions? So when you ask the question is there a basis for moving quickly for control, I have to answer with a resounding yes on the basis of the aquatic ecosystems alone. We are simply not prepared to contemplate leaving the generations of the next century with tens of thousands or hundreds of thousands of sterile lakes which is what we are talking about in terms of aquatic ecosystems. This is an area we know a lot about. We know that it is happening. The area that is much more doubtful, although I do not know how much more doubtful, is the area of soil chemistry which we just finished discussing. Another area which is not in doubt is property damage. We know we are causing damage to building faces, to cars, and a lot of other things. A lot of things are being documented to demonstrate that. If you write that into a macro-economic setting and you calculate how much is involved, spreading it over a large populated area such as we are talking about in both Eastern Canada and Eastern United States, then you are talking about enormous amounts of money. I am convinced of that.

Bob Flacke, New York: We are pleased to see that New York's problem in the Adirondacks and the proven destruction of 107 lakes and several more is also evident beyond our borders and not only has elevated itself to a Regional problem but a National problem. We, too, have concluded that it is now time for source control based upon what has been presented today and on evidence that we have gathered over a number of years. You will notice that many of the slides emanated from New York's data gathering which has been part of both our academic community and natural resource management for many decades. Thank you.

Dr. Gage: I can only underscore what Ray has said in terms of damage to human structures. We have initiated a project under the Committee on Challenges to Modern Society which is a civilian arm of NATO and we are finding that it is not just the Scandinavians, Norwegians, and Swedes who are interested in participating with us in that particular project. It is all the countries of Western Europe who have a very real concern for their cultural heritage and the project, in fact, is being lead by the Greeks who are very concerned about the destruction of the Parthenon and Acropolis. They can literally see effects there occurring on a yearly basis, quite dramatic effects. Yes, Tony.

Tony Cortese, Environmental Commissioner of Massachusetts: I have a difficult question to ask Steve. Conspicuous by its absence in your presentation of what the President's program is on acid rain was the planned program for control and I know we are going to be talking about that tomorrow. The President has launched through EPA an ambitious $10 million a year-ten year program for research on the acid rain problem. I assume that does not mean that EPA is going to suggest that we wait ten years before we begin to apply controls. I guess my question to the panel is, and I know it is somewhat unfair because you are the research arm of the agency, my question to the panel is: How long should we wait and if we are going to wait two to three years or more before we begin to make a decision, make a final decision on controls, and it takes three to five years to get the controls on, are we likely to cause more irreversible damage than we have already caused by acid precipitation?

Dr. Gage: That is a good tough question, Tony. I think that Doug Costle signaled in his opening statement today that we are not going to wait for all of the research results to be in to begin taking actions. I think he said it very clearly, we need to translate from the research results we have today, meaningful steps towards putting a cap on emissions and moving to the tougher step of reducing the current levels of emissions. All through the process we are undoubtedly going to have to learn to live with a much higher degree of uncertainty by not having the scientific and technological information at hand to make the firmest of decisions. The research plan, of course, is not a plan which is just now being laid out. We, in fact, took a lead, followed very closely by the U.S. Department of Agriculture, TVA, DOE, NOAA, and several other agencies as well started dealing with this problem several years ago. If we did not have those research activities underway right now, I think we would be in much worse shape but there are going to be results coming out on a monthly basis through the next 12 to 18 to 24 months. That will give us a great deal more insight into the short-term impacts. It will, very frankly, not give us any appreciable insight into the long-term impacts on the soil ecosystems and on forest ecosystems. With the very long time constants that are involved in those systems, we are, quite frankly, going to have to hedge our bets in the level of control activities we are willing to afford as a country to protect the long-term integrity of the soil and forest ecosystems. But, I think that you heard very clearly from Ellis and Ray that we have enough data on hand at this point to fairly well indict acid precipitation as a major, if not the predominant contributor to the deterioration of aquatic lake ecosystems. I think we are going to be starting tomorrow with Dave Hawkins' opening statement, a very serious discussion of what alternatives we can undertake so that we can join together in discussing how we begin to take those first steps.

Tony Cortese, Massachusetts: I have one follow-up question, Steve, and that is: How likely a situation is it, if the longer we wait before we begin to apply controls, the more we come into a situation where the life of the existing coal-fired power plants become short enough that the economics tip it away from applying the control technology that is available right now. I know Steve didn't have any data on that in his slide presentation but I am curious about that because I wonder if it does take us five or ten years to make a decision, do we then find ourselves with a problem in the long run because we cannot afford to begin to apply technology to existing power plants because it just will not be worth it because they will be too old and they will be phased out.

Dr Gage: Well, of course, with interest rates running at 19 1/2 to 20 percent we seemingly have a different economic order. There will probably be some different economic rules applying to the affected lifetime of a capital plant. Steve, can you add some comment to that with particular respect to the Ohio Valley study.

Steve Reznek: I guess Lowell will give more detail on the Ohio Valley Study. There was a major expansion in electricity generating capacity in the late sixties and the seventies and then a small expansion just before the embargo in 1975 or so. So a lot of the plants date from those times. Before the embargo, it would have seemed like they would be aging now. However, with new capital going sky high maybe those plants will last considerably longer than the thirty year life they were originally projected to have. Lowell wants to talk about how that lifetime . . . split out in the Ohio Valley now. Lowell Smith: This is one of the areas that I alluded to that makes it very hard to predict what future emission rates will be. We really do not know what the utility executives plan for the retirement for the existing capital stock, but, we do not know what the shape of the capital stock or shape of the age distribution of that capital stock is. If we were to plot up a cumulative distribution of retirement date versus the total capacity retiring, assuming a thirty-five year operating life for those plants, in the six Ohio River Basin States, we would see that only a third of those plants would be retired before 1995. The remaining two thirds would run over a fairly linear curve between 1995 and 2010. However, we are beginning to rethink that thirty-five year lifetime. We do know that boilers are continually retubed since it is the tubes of the boiler that tend to wear out and they can be replaced and there are a lot of tax policies and policies that the State Regulatory Commissions for the industry have which determine the probable retirement dates for those plants more than anything else as well as what the cost of capital is for replacing. We really cannot answer the question at all precisely. All we can do is say this is what the age distribution is. Here is what might happen under a different "what if" type scenario.

Craig Weidensaul, State of Ohio: I have a question for Dr. Cowling. Ellis, about, four years ago we initially sat down to discuss the deposition monitoring program which, at that time, was one that would hopefully materialize. I think we all agreed that there was a great insufficiency of data and a lack of reliable information in the U.S.--whether it be different methodologies used in collecting and analyzing precipitation or whether there were insufficient numbers of sites and improperly located, and so forth. The justification for our national atmospheric deposition program was based primarily on the fact that we did not have information in the U.S. of a reliable nature. We have collected data for 17 or 18 months now and I have, as you know, been very familiar with those data. We have also come to the conclusion, I say we figuratively, in this room and across the nation that the acidity of rain has increased significantly. In our proposal for the establishment of the monitoring system, we indicated that the only reliable data could be generated over a period of many years. Yet we are already making a conclusion that we have significantly increased levels of precipitation and acidity. Would you be willing to go out on the limb and agree with that or do you think maybe we should tread lightly and really find out what the answers are before we run off in all directions proclaiming great increases in acidity.

Dr. Cowling: Let me answer in this way Craig. I think that if we look at any of the monitoring network data that is available--maps or NADP or the TVA data or, country and one has to doubt in some ways the reliability of the WMO data, but nevertheless--there are certain trends and I think that data is persuasive that over rather long periods of time there are significant increases in the amount of acid being deposited over the landscape. I think if we were to take any set of data over a period as short as you mentioned, 18 months, which is as long as we have data in the NADP network, I don't think that that is adequate, using that data alone as an inference. I might just call attention to the slide from the Hinkley Reservoir. Over any given period of ten years you could tell any sort of a story you want with that data. You could say that the alkalinity was increasing over a period of ten years, you could say it was decreasing over a period of ten years, or at another time you could say it was holding constant. I do not consider it relevant that over this particular 18 months we have seen any change at all in terms of the question that you raised, but I do think it relevant that we know that emissions are increasing in various regions of the country and in response to the question asked by the representative from West Virginia, I think it is important to recognize the difference between national trends in emissions and regional trends in emissions.

In the Southern United States region, the projections for increases in emissions are much more substantial than they are, for example, in the Northeastern part of the country. So, though New York has a good reason for worrying now, North Carolina may have good reason for worrying later. That suggests that we need a stable monitoring base that will exist over decades of time. We need to find some way to ensure that it is isolated from the political winds of change. I think there is substantial evidence with which to piece together from a variety of sources which emission inventories are major. The film which we were talking about today demonstrate how large distances, we are talking about in terms of dispersal, have good reason to be concerned about the interstate and international dispersal now.

Dr. Galloway: I would like to add a comment to that if I may. I second what Ellis has said, realizing that there are two main questions we are concerned with. First of all: is the acidity of precipitation now greater than it used to be before we were burning substantial quantities of fossil fuel in the U.S., indeed in North America? Secondly: are there effects of this increased acidity? I think the answer to both those questions is yes.

Dr. Gage: There is one question from the audience, and just to make good on my promise to work these in at appropriate points, the question is: Wasn't coal combustion much greater in the 40s and 50s than it is today? If so, why is the trend toward a more serious acid rain problem today? This is by Tom Curtis, of the National Governor's Association. Lowell, would you like to take a stab at that?

Mr. Smith: Sure. The initial premise of the question was that we are burning at least as much coal today as we were back in the 1940s and 1950s. We are actually burning a little more coal today. Historically, coal consumption, with some ups and downs which were a function of our economic activity, has been around 500 to 600 million tons per year from about 1920 through about 1970, in fact through about 1975. Since then, coal consumption has jumped up to 700 million tons and as we all can expect will be rising even higher. The real point here though, is what are the SO_2 emissions. From the graphs that I showed, SO_2 emissions in 1940 were about 20 million tons a year, that was primarily because we were not burning as much oil in 1940 as we are in 1980. Now we are emitting about 30 million tons of SO_2 per year, so emissions for SO_2 have risen by about 50%. More importantly than that is height into the atmosphere that we inject these emissions. We are not just burning coal in everybody's home fireplace or home furnace, and we are burning it as we saw in large electric generating stations that have stack heights of 200 to 250 meters. This is injected into the atmosphere at points were they can travel much further distances, and have a much longer time to react chemically. Also, we have a more oxidizing atmosphere today because of our automobile emissions; we have many free radicals in the atmosphere that tend to turn that SO_2 into acid much more rapidly. Finally, we all have to recognize that we not only have somewhat increased SO_2 emissions that are injected into a more reactive atmosphere, but we have the nitrates the nitric acid components building very rapidly at this time. We have a number of factors which, all added together, can certainly account for substantially more acid being deposited today than was being deposited back in 1940, even though we are burning about the same amount of coal--to within 25%--as we were in 1940.

Dr. Gage: Questions here?

Mr. Paul Leroy, Technical Representative from the State of New Jersey. Ken Demerjian, you presented a very eloquent slide presentation on your modeling results on the actual SO_2 emission inventories which we know of today. Since our problem is regional--interstate boundary in its integrity. You showed Regions I, II, and III being impacted slightly more severely by various regions, extramural or extraregional to it. Have you done any analyses which would indicate that by controlling emissions in various locations--i.e., in various regulatory regions, more severely or let's say with more judicious nature than may be apparent due to the emission density at this particular time--have you seen reductions? Have you done the options situation? The ones that are not real . . . at this particular time. What would happen if you controlled SO_2 emissions let's say more in Region V than you do now, or Region II than you do now, or various combinations thereof.

Dr. Demerjian: The answer is yes to some extent. There is continued work being done to apply the model to various emission scenarios. Within the study that I have been commenting on today, there is a scenario for 1985 projected emissions based on an inventory prepared by the Department of Energy. I did not show any of the results from those model runs, but the projected emissions did show reductions in several areas of the modeling region both in terms of SO_2 and sulfate ambient levels. I am not prepared to comment on the methodology used by DOE in developing these emission projections, maybe Lowell Smith has a better knowledge of the technique used. It was considered the best available projection for 1985 at the time. We run the model with the projected emissions for comparison purposes using the same meteorological data set for the 1977 test year. The model is capable of at least scoping out the impacts of such control strategy scenarios and certainly is a useful tool for that kind of preliminary application. Some of the future model application work includes further emission projection studies with emphasis on regional exchanges and impacts on highly sensitive ecosystem receptor areas.

Mr. Smith: Just in passing the mike back to Steve, I will just comment that we may not necessarily agree with the Department of Energy's 1985 projected emissions, there are a number of reasons for saying that. Without going into them all, let me just say, all future emission estimates are highly dependent on the degree of compliance with existing SIPs or the emission limits for State implemetation plan controlled plants, and other factors which as we know are somewhat variable over time.

Dr. Gage: Carl, West Virginia.

Mr. Carl Beard: Dr. Gage, has EPA received any concerns from the holders of commercial timber, be it pulp and paper, hardwood, or what have you? Has anybody voiced any concerns about acid rain damage?

Dr. Gage: I think we have received a number of inquiries from a variety of the forest associations in EPA, but I think that probably Ellis, who is much closer to the forest industry than we are, might comment on that.

Dr. Cowling: International Paper Company is the largest single owner of forests or timberland in the United States, and the Vice President for Research is very much concerned about the problem. Weyerhaeuser Corporation shares that concern. We have established a new center in Raleigh for southern forest land productivity. Russ Ballard, the chief soil scientist involved in that project is very conscious, also Carol Wells at the forestry sciences laboratory. Since this point is related to an earlier question, I might also comment that Dennis Tirpak has reminded me of the Soil Survey Data System that is used in Sweden and is run by Trepe Trodeson. They have a very elaborate system for soil chemical analyses by Horizions in Sweden. That system is not now used in this country, but could be adapted and would give us some idea about the distribution of nutrient elements among soil layers which would give us additional information that would be germane to the question of forest growth and productivity.

Dr. Gage: I would say that the Forest Service in the U.S. Department of Agriculture has been most aggressive among the many bureaus in that department in working in the acid rain area, and we want to encourage them even more. We also want to encourage our friends from the soil conservation service and several of the other major bureaus or departments to use any major resources that they have available in the extension service or the land grant universities to focus on this problem.

Dr. Cowling: Don Boelter of the U.S. Forest Service is here; he might just raise his hand. Don are you still here? Yes, in the back. Good job. You might also remember that it was the Forest Service that sponsored the Ohio Conference, which was the first international conference on acid precipitation/forest ecosystems, so the Forest Service is keenly concerned.

Dr. Gage: Yes.

Mr. Daniel J. Goodwin: I am Dan Goodwin with the Illinois EPA. I will address my question to either of the two Steves that can answer it, or maybe the two of them together. Steve Reznek mentioned--but then said nothing very substantive about--nonstructural approaches, the least emissions dispatching concept, plant retirement schedules, the way you have them listed here, there are other things that you can throw into that category. My question is: Was that not discussed because nothing is going on at the Federal level in that regard, or because it is a DOE area of interest, or what? It seems to me that it is potentially a very fruitful area for short-term gains that could be implemented within a matter of a couple of years with no need for Federal legislation.

Mr. Reznek: It is a very interesting field. By the way, I am reminded of a better answer made by Tony's question, in that old power plants never die, their load factors just go down. We are developing a knowledge base of what dispatch algorithyms of current utilities are and what their supply capabilities are. We are also aware of the power interchange arrangements that are already in place amongst regional collections of utilities. There have been some very good cooperative cost-letting adventures between individual utilities in different States. The rate setting commissions have allowed those to occur when there is a cost savings involved. We are going to put that information together, we are also, frankly, going to be very sure that we do not walk into--if I can mix my metaphor--into windmills where we have not thought thru whose toes will get stepped on and who realizes what savings. That information will be available, we have just started the process of looking at it, and looking at what some of the potential savings may be. The only reason I did not talk about it in detail is one, we are not very far into the process, and two, we are afraid of charging ahead and not realizing that we suddenly put a major utility out of business and brought power into its area without knowing what we were doing. Lowell, you want to comment a little bit?

Mr. Smith: O.k. Simply to comment that both Steve Gage and Dave Hawkins are jointly sponsoring analysis in this area. It is a three-phased analysis where we are looking at the acid rain emission region as a whole, first of all in the first stage, those results will be available next month, at least for internal review. Second phase will be available next fall, where we will be looking more in detail at individual utility systems, both where we will have greater detailed analysis of what this so-called least emissions dispatch might mean, what early retirements might mean, what other policy initiatives to address this question might mean. Also, in the Ohio River Basin Energy Study, whose draft report will be out next week for review and comment, there will be further analysis in this area as well.

Dr. Gage: Yes.

Mr. Brown: Will Brown, New Hampshire. As a forester I certainly share the uncertainty as to the terrestrial impact of acid rain, but I wondered whether that needs to give us any pause because there seems to be general agreement from the panel and certainly from the questions that have been asked, that the aquatic impacts are sufficient to justify action now. I did hear some mention about benefit to the alkaline lands from acid rain, but unless we can recycle the jet stream in the opposite direction, I do not think we are going to be able to deliver much of it out that direction. I have not hear anybody say that there were any potential beneficial terrestrial impacts on nonbuffered soils with which we are blessed in much of the Northeast.

Dr. Gage: Point well taken. Yes.

Mr. Collom: Bob Collom from Georgia. I was wondering if Dr. Cowling could go further into the aquatic effects and that is: Is the adverse effect on fish due to the absolute pH concentration of the water, or the rate of change, like the immediate snow melt that occurs in the North?

Dr. Cowling: I am afraid I may be misleading in suggesting that acidity per se kills fish. There may be circumstances where that is true, but for the most part it is the associated metal ion toxicity that is far more worrisome than the simple effects of pH. Particularly on mature fish. There are certain circumstances under which extreme acid stress may be experienced by fish, and I am not a fish biologist so I am having to give you second hand information. Dr. Harvey, in Canada, has shown fish that have a distorted backbone structure, the crippled appearance. This is due to the continual necessity for resorption of calcium out of its own bone structure in order to maintain an ionic equilibrium with the surrounding water. Now that is an acidity effect, but it does not kill fish, it simply deforms them. It depends upon what your concerns are for the fish. I think we are able to recognize that acidity is not good for fish under any circumstances. Aluminum toxicity which clogs the gill membrane, and maintaining blood level calcium concentrations that are suitable for the internal physiology of the fish are the two primary effects of which the most important by far is the metal ion toxicity.

Dr. Gage: It is the absolute concentration of these metals as opposed to some rapid rate of change that seems to cause the problem, is that right?

Dr. Cowling: Yes. There are circumstances in which the fish are intolerant to the rapid rate of change, as when you get a very rapid accumulation. There were some illustrations shown in Norway of the accumulation of aluminum precipitates on the gill structure, they are shown open looking like a cone, and then they are shown essentially as closed. Apparently that precipitation on the gill membrane can occur with great rapidity. It is a shock and the fish actually die in many cases from lack of oxygen.

Dr. Gage: One of the developments in our Duluth Laborabory has been the fish meter in which the response of the fish to the clearing of particularly toxic metals from the gills can be converted into a pressure pulse which can be picked up with a very sensitive probe. The scientist can measure well down below the parts per million level of concentrations of toxic metals in the water, just by looking at these little fish coughs or gill cleaning responses in the fish to very very low levels of toxic metals. So, it is not at all unlikely that the higher levels smother the gill action which really leads to a toxic effect in the fish.

Dr. Cowling: Jim Galloway has just reminded me that the acidity per se is much more deleterious upon the fish fry than it is upon mature fish. The adult fish are reasonably tolerant except for the calcium adsorption business.

Dr. Gage: Yes.

Mr. Martini: Bob Martini from the Wisconsin Department of Natural Resources. Wisconsin has a very large number of susceptible lakes and we also have acid deposition as we have already measured. I have been reading recently in your five year plan for research that EPA has developed, through a contract with the Mitre Corporation. I do not see very much in the way of work outside of the Northeast for any other region in the United States. I wondered if you could comment on the distribution of those research funds to document problems that we feel are already occurring in other parts of the country and the ability of the States to carry out a program to demonstrate their own susceptibility and the problems that they are having in areas outside the Northeast.

Dr. Gage: Since that plan was drafted some 9 to 10 months ago, we have made a number of changes which give a much better balance to our efforts. Even at that time, we had Dr. Garry Glass at our Duluth Laboratory involved in a very extensive study of the Boundary Waters Canoe Area in Northern Minnesota, where he found many of the lakes highly susceptible to acidification and also found fairly good evidence of increased acidification in those lakes. He has subsequently extended that work to the Northern Wisconsin area and I believe there are contacts with a number of academic people in that area. One of the results of the dialogue that has already been established in setting up this particular conference is the much greater feedback we are already getting from the States. This is in partial response to one of the other written questions we have here. We would like, following this meeting, in conjunction with our regional offices, to have a survey performed of all the activities that you are conducting in the States so that we can, in some cases, possibly be an information broker in getting information from State to State, but also know what you have underway so that we can incorporate that in the various studies we have going on in either our laboratories, the national laboratories, or university laboratories through our consortium which is basically run by Ellis. We will take that feedback and probably carry out even more of a balancing of the distribution of our research funds than we have today.

Dr. Cowling: If I could further comment. I think it is important to realize that EPA has money to spend but it does not have it all by any means. The amount of investment being made by other agencies including the Fish and Wildlife Service, the Forest Service, the various States agencies that are concerned with the research, the U.S. Geological Survey is making very substantial investments in this area, NOAA has intentions to make a much more substantial investment. I think you are going to see not just EPA making a decision about where the investments ought to be made. The State Agricultural Experiment Stations are increasing their investments. I do not think you are going to see a major concentration of Federal funds by any means in the Northeastern quadrant alone.

Dr. Gage: Yes, over here please.

Bob Schrieber: Bob Schrieber with the State of Missouri. EPA is currently developing a fine particulate standard, or a respirable particulate standard. Have they done any work to identify what percent sulfates may play in that particular standard? If so, what respirable particulate standard would be the controlling factor for sulfates?

Dr. Gage: We are in the process right now of reviewing the scientific basis for the sulfur oxide particulate standard. In fact, for some number of months, we have been developing the criteria document for SO_x and particulate. That criteria document will be available within the next few day and will be sent out for two to three months of very wide public review as well as detailed review by our Science Advisory Board. In that document, the role of the respirable particulates are addressed as far as the total particulate problem but at this time there is not a separate document prepared on the respirable particulates to support a separate standard, but rather the total effects of the respirable particulates. The relative contributions of the secondary pollutants such as the sulfate are discussed as part of that combined sulfur oxide particulate problem. Unfortunately the timing of this meeting was somewhat out of sync with the conclusion of the preparation of the criteria document but please note that in the Federal Register within a few days we will have the announcement of its availablity.

Bob Flacke: Will that automatically be sent to the State Air Agencies?

Dr. Gage: I think so, if not, I will take the responsibility to see that each official State representative here gets a copy of the criteria document. Yes.

Mr. Wilms: I am Paul Wilms. I am with the State of North Carolina. I have heard a lot of talk today from various States and a number of the speakers to the effect that additional controls on stationary sources--especially sulfur oxides, etc.--may be necessary, maybe not as the panacea, but simply as Dr. Cowling mentioned to gain some additional time for this study. This may be a point of further discussion tomorrow, if not, I would like it to be. I would like us to ponder this evening and then discuss tomorrow, alternatives either in addition to or in lieu of additional stationary source controls. If those controls are necessary on stationary sources, I would like some response particularly from EPA as to what form they might take. Whether they would be Federally promulgated emission controls for existing sources or whether they would be simply Federally mandated controls for the States to formulate and adopt after control technology guidance is promulgated or whatever.

Dr. Gage: Well I know Dave Hawkins will be discussing in his opening remarks tomorrow the structure of the Clean Air Act and the use of the various mechanisms under the Clean Air Act including the possible use of the secondary standards; all of the time constants that are built into the promulgation of revisions; the state implementation plans; and the time required to make changes--all this in the context of the urgency of beginning to deal with the acid rain problem. I think you will have very ample opportunity tomorrow to address precisely the kind of questions that you are talking about. Ray indicates that there are 200 hundred copies of his speech across the hall in the press room, so if you would like to have a copy of his speech, it will be available there. Yes, Tony.

Dr. Cortese, Massachusetts: I have two technical questions. First, can we affect fish life by changes in pH which could affect the type and number of micro-organisms which would exist in lakes or in rivers and streams? Second, can we affect the kinds of micro-organisms which help in nitrogen fixation and other kinds of processes which help plant growth by changes in pH?

Dr. Gage: Ellis, would you take that?

Dr. Cowling: With response to your question about the fish life and other organisms living in streams and surface waters, it is very clear that the affects of acid deposition and the associated metal ion toxicity have influences at all trophic levels. Algae will be affected, diatone communities will be affected, bethnic invertebrates would be affected, emergent vegetation would be affected, and so on. The data to support this is primarily from Scandinavia although I think essentially similary observations have been made in Canada. It is very clear that we can expect major changes in the character of the vegetation existing in lakes and streams. One of those changes will be to inhibit bacterial decomposition which will also have the effect of increasing populations that will be directly competitive for oxygen with the fish so that there could be direct competitive effects from changes in acidity of the soil. Then the second question, yes, David Shriner first demonstrated the effects on the nodulation of soy bean and kidney bean as I showed in the slide. He did experiments which excluded the acidified water from the soil. He found the same extent of inhibition of nodulation, whether or not the precipitation ever contacted the soil. I think it is very clear that we could increase the nitrogen fertilization costs if those effects became general. It is not just a question of soil alkalinity or acidity or the pH of the soil, it is a question of what happens when the precipitation first hits the vegetation. It is not widely understood that most raindrops do not enter the soil directly. They do in an agricultural field where there is no crop, but most of the time, especially in a forest, it will trickle over three tiers of foliage before it will hit the ground, and there is plenty of opportunity for physiological interaction with the foliage.

Dr. Gage: I think one of the most dramatic examples of accumulation in aquatic systems, that has been pointed out to me, is the growth of sphagnam moss along the bottom of the lakes particularly in Southern Scandinavia where the moss grows out from the shore and starts to blanket the bottom of the lakes, basically smothering all the biological activity that lives at the interface between the water and the sediments underneath.

Dr. Cowling: That same situation has now been detected in the United States and in Canada, so we now have another phenomenon to look forward to. In addition, with sphagnam, it has a very large and estranged capacity in its foliar surfaces. It is normally a terrestrial plant, but when you acidify a lake it invades the lake bottom. It has been detected in Sweden as far down as 18 meters which is 51 feet. If you lime a lake, you will tend to kill off the sphagnam. If in the meantime heavy metal ions have accumulated on the foliar surfaces of the sphagnam, you will release them into the water again, so you can blacklist the lake by liming it for the purpose of increasing the likelihood of reproduction of fish in the very same body of water. We are really dealing with a very complex web and if you wiggle the web there are pertubations in that chain that will be felt over substantial periods of time.

Dr. Gage: Yes.

Tony Cortese: Ellis, I would like you to clarify a point. You said something that did not make sense to me. You mentioned that bacteria would be killed, but yet there would be a substantial growth of algae. Without bacterial degradation of organic matter, two things will happen, one there will be no nutrient cycling for the algae and they cannot grow; and two, with the accumulation of organic matter you have tied up a lot of the heavy metal, I do not think you meant to say that, did you?

Dr. Cowling: Well, it is a question of short-term versus long-term effects. In the long-term you are right and in the short-term I think I am right. I have some other illustrations of the slimy accumulation of algae on rock surfaces for example. That does occur, the bacteria are inhibited sufficiently so that the algae gets the upper hand in the balance bewteen the two populations.

Dr. Gage: Yes, Bob.

Mr. Bob Collom: I would like to address Dr. Galloway. The Scientific American article compared say a 20 to 25 year period. How comparable is the data from the 50s to that now being gathered as far as methodology of sampling and analysis?

Dr. Galloway: The methodology sampling and analysis were different between the samples collected in the 50s, the mid-60s, and in 72. One of the advantages of doing annual averages of pH is that you tend to smooth out these changes in technique. I feel confident that there have been increases in precipitation acidity, especially in the Southeastern United States, as that data show. Also, getting back to the acidic question, has the acidity of precipitation in the Eastern North America increased since we started burning fossil fuels at the rate we are now, and the answer to that has to be yes. No question about it.

Dr. Gage: Are there other questions? There is one question that I received from the floor that I hesitate to toss to the panel now. It is not identified by question, and I would not rule it out just on that point, but I will read the question and maybe it could be clarified and asked again tomorrow. The question is: The President's Commission on the Increased Utilization of Coal concluded that at the present the proposed mass conversion of electric utilities to coal would not increase sulfur emission under existing EPA standards. How could they come to this conclusion if EPA has acknowledged that this is not the case? I guess we have a little problem with the premise in the first question, maybe you can grab some of the people from EPA and get that question sharpened up a little bit more for tomorrow.

Mr. Hawkins: By way of an interim answer, I know that some of you . . . were invited . . . you might want to jump in, but a quick review of the Commission report indicates there are a variety of measures proposed in that report, some of which tend to increase . . . and others which tend to provide offsetting reductions. The principal ones which would tend to provide offsetting reductions are related to policies that would accelerate . . . I think the whole Commission study does show that conversion by itself would result in some emission increase, but the total program also includes elements which would have offsetting reductions.

Dr. Gage: Thank you, Dave. Well we are at 5:57; it has been an absolutely orderly meeting; I do not really take responsibility for it; we have been right on schedule; and I think now is a good time to conclude today's session. Tommorrow's session will open at 9:00 a.m. in this room--Dave Hawkins will be the moderator. The emphasis will be primarily on the discussion of various regulatory and other options that might be used to deal with the acid rain problem. We have a number of presentations from State representatives, who have been thinking very hard about the problem. I think tomorrow offers to be another very good day. I want to thank the panel members, who have given the presentations this afternoon. They were first rate professional presentations, and did an awful lot to set the basis for tomorrow's discussion. Thank all of you who have attended today.

DAY TWO

Mr. Hawkins: I want to welcome you all once again. The intent today is to follow up where yesterday's discussion left off. Yesterday we focused principally on the scientific and technical facts and issues associated with the phenomena of acid rain and long-range transport of air pollutants. Today we are going to be talking about institutional, legal, political, economic, and social issues. From EPA's perspective we are going to be talking about them in terms of questions and, hopefully, in terms of answers that the States feel comfortable in articulating.

Our sense of the usefulness of today's session is to lay some options on the table and to have the various States discuss their view of those options as well as identifying others which we may not have identified. Principally my initial remarks will focus on two sets of options. First, what possible legal tools under our current authority may exist and second, what legal tools other than our current authority might hold some promise.

I would like to start off with an assessment of our current legal authority. I would like to emphasize that in EPA's view this is not a conclusive assessment, it is rather an identification of possible sections of the law that might or might not hold some promise, and rather than expressing a firm conclusion on that this morning, I want to lay out some of the pros and cons of each, and have the participants in the conference attempt to identify other pros and cons, or other options under our current authority as well as other authorities. Let me try to run through a list of possibilities. These are in no particular order of priority.

First, the stack height regulations. As you know under Section 123 of the law we are required to adopt regulations that give credit for stack heights. We have some discretion as to the amount of credit we can give, and clearly to the extent that we exercise that discretion to give the maximum amount that might be available under the law, that could lead to greater allowable emission limits than if we exercise that discretion to provide the minimum amount of credit that is available under the law.

So, one option we have is to structure those regulations in a way that does not give more credit than is mandated by the law and as a result, does not give the sources an opportunity to justify higher emission limitations than would be mandated by the law. The plus side is that it is our feeling that a large number of current SIP relaxations as well as current SIP regulations may be based on higher than minimum stack height credit that might be justified. If this is the case, then a very tight regulatory policy could in fact provide for some reduction in emissions. On the negative side, the resource implications of reviewing all existing sources is substantial and if that is to be done by EPA itself, it would take a considerable amount of time. If the States are also interested in reviewing sources within their States or sources within other States, then obviously the resource base would be substantially expanded. I think it is still a fact that in the air pollution area about 90% of the resources in terms of personnel are at the State and local level, and 10% at the Federal level. Some of the other negative factors are that there may be legitimate stack height increases which, under a tight policy, would have to undergo substantially greater burdens in order to justify their increases, which could result in delays in legitimate modifications to SIPs. In addition, it is our initial assessment that the total magnitude of emission reductions that one might get by operating within the boundaries of our discretion, is not an enormous fraction of the current loadings.

Another area is Section 115 with respect to international pollution abatement. That section does allow a foreign country to trigger a Federal call for SIP changes in order to deal with source impacts on that foreign country. The authority is fairly broad and it could relate to impacts that are not associated with criteria pollutants, so it could be used to address to the acid rain phenomena. The negative side of it is that it does rely on the state implementation plan process. It would probably deal principally with sources that are fairly close to our international boundaries and where we are fairly able to identify the impacts rather clearly on the acid rain phenomena and that may not be too many sources. Finally, it may indeed require an additional international agreement in order to meet the requirements of Section 115.

Third item is the improved enforcement and enforcement monitoring. We could pursue the enforcement monitoring activities much more agressively so that we have a very accurate picture of whether current emission limitations are being complied with, and take enforcement actions against those sources which are not in compliance. We also have estimates that that would allow us to find some emission reductions from today's existing emission levels. That is one of the positive features, another of the positive features is that it could lead to improved operation and maintenance practices at large stationary sources. I think that historically the air pollution community has tended to focus on getting the equipment installed and not place as much emphasis on seeing that it is operated on a daily basis and to its maximum potential. In flue gas desulfurization areas it is particularly important that we focus on the actual operation because a little bit of down time can make a large difference in the total reductions over the course of a year. It would also force EPA and the States to clarify the averaging times involved in their current emission limitations. As long as there is uncertainty in that area, we will have some difficulty in establishing the actual violations or compliance status of sources. It might lead to practices that would reduce sulfur variability, that could reduce peaks but it would not necessarily reduce total loadings, and as I mentioned, it could substantially reduce emissions and finally have positive equity implications. Now, of course, again an issue that is present here is the resource implications, and it depends again on whether this would be an initiative that EPA would undertake by itself or be an initiative which would be shared by the States. Again, to the extent it is shared by the States, those resources would be much more available. Another negative factor is that it is quite possible that enforcement against sources could disrupt some current coal market relationships, and that is a fact of life that we are all going to have to deal with. I do not mean deal with by backing away from dealing with an abatement problem, but we have to recognize that where there is that kind of dislocation, we are going to have to figure out a way to make people feel comfortable with bringing sources into compliance.

Another option is to assess our modeling guidelines and require best techniques to be employed and to go back and remodel sources and SIP limits using those best techniques. I think that around the country, depending on when the SIP limits were set, you have a wide variety of techniques that have been employed in modeling sources for calculating emission limitations. We could tighten up on a variety of those parameters, and probably wind up establishing, even under our current ambient system, a set of tighter emission limits. There are a variety of suboptions here, we could do that for all sources, we could do it for the largest emitting sources, and we could do it for sources that are seeking SIP relaxations. The positive aspects are that this modeling could in fact . . . many emission limits based on old, less rigorous techniques that are too lenient. It could force reduced emissions and improve the overall quality of the SIPs. If we took the suboption of limiting it to SIP relaxations it could tend to deter those relaxations. The negative side is that the modeling might show that some emission limitations are more stringent than necessary, and I say negative from the point of view of an objective of reducing total loading. Another familiar negative point is resource implications, and again if this is an exercise which EPA would be undertaking, it would take some time to do if we were doing it for all of the Eastern States. Then there is the issue of equity. If we take some subset which happens to fall on a particular group of plants or particular group of States and only those are chose to be modeled, obviously, again, if EPA is the only one engaging in this initiative, we would obviously start first with somebody, and cries of inequity might be heard.

Another area is Section 126 of the Act, the Interstate Pollution Abatement Activity. Here we have the option of taking a more aggressive role in dealing with the requirements in identifying and clarifying the requirements that a State must meet in order to make these showings. I think it is safe to say that that is an option which we have already decided is positive, and we are going to try to take a more active role in the interstate area. Specifically by taking the interpretation that if a State can show that a source in another State is unreasonably interfering with the air quality margin of growth in the impacted States, that that is enough to make a prima facia showing (that is lawyer's talk for getting in the door) to hold such a proceeding. The remedies remain to be seen, but the intent would be to enter into an arbitration process that would get the States to agree on some limit which were thought to be acceptable to both States, and would tend to reduce the impact in the affected State. Now, the pros in this are that it would be repsonsive to some of the most insistent complaints we have heard about the inequities of widely differing emission limitations which are believed to have substantial impacts in States with more stringent emission limitations. It would put the State most immediately involved across the table from each other, so they could start talking seriously about a resolution to this problem, recognizing that EPA has this backup authority to impose an arbitrated solution, if necessary. The negative side of it is that section 126 is related to criteria pollutants so it would be necessary to show impacts on sulfur dioxide concentrations, PSD concentrations, and nitrogen oxide concentrations, rather than showing the impact on the ecosystem of a substantial acid deposition. This means that it would be most likely limited to close-range microscale impacts rather than the long-range transport-import impacts that appear to be a substantial part of the acid rain problem. It would probably have to be done largely, at least at present, on a plant-by-plant basis and the tools that we have to tie impacts to a variety of plants are not as rigorous as the tools we have on a plant-by-plant basis. We are proceeding to try out this authority and the first hearing will be held next week involving the petition between Kentucky and Indiana. We will see what comes of that.

Another item is developing an ambient standard, and there are several different options for ambient standards. One is to set an ambient standard for a conversion product that is related to acid rain--

say sulfates--or to set a tight secondary sulfur dioxide standard, or to set a respirable or inhalable particulate standard. The positive side is that, if stringent standards were set, they would tend to increase the degree of control required on the precursor pollutants, depending which option were chosen, either for sulfur dioxide or nitrogen oxide or both, and that in turn would lead to additional control opportunities. The negative side is that we do not, today, have in hand doucments that assemble a broad amount of information that would result in a substantially more stringent emission limitation, most likely coming out of the process. To some extent, that is a forecast of a process that we are still in the middle of with respect to the sulfur oxide and TSP criteria document review. The regulatory side of this Agency is not all that familiar with the draft criteria document, and as Steve Gage indicated to you, all the registrants here will all be getting copies of that draft and you may be able to form some judgements, as we will, of the potential of that option. Another negative factor is that because it involved the SIP process, the timeframe is rather lengthy. We have a year or so process before the ambient standards are locked into a promulgated form. There are opportunities for litigation on that. The schedule for submission of plans is either 9 to 27 months depending on whether we are talking about health- or welfare-based standards or whether a State asks for an extension. If we are talking about welfare based standards, the current law sets an attainment date as a reasonable time. We can attempt to establish some criteria for what constitutes a reasonable time, but we do not have the tight deadlines for attainment demonstrations that we do in the primary standards area.

Yet another option is the exploration of the use of Section 111d of the Clean Air Act where we would need to require controls on some noncriteria pollutants that are associated with the acid precipitation problem, if we identified such noncriteria pollutant or pollutants that would trigger an obligation on the part of the State to adopt regulations for existing sources of those pollutant(s), again through the SIP process. The positive aspect of that is that it triggers the SIP process perhaps more quickly than setting an ambient standard would, especially if we had to do additional research prior to setting an ambient standard. The second positive aspect is that it avoids dispersion model gaming. That is, it is a technology based requirement--even though it is adopted through the SIP it is technology and hiring meteorologists do not necessarily wind up giving you a relaxed emission limit because your emission limit does not depend on the dispersion models. Sorry for that slight against meteorologists, Walter. The final aspect of the positive side is that it does allow tailoring. We could establish guidance for categories or subcategories of plants that appear to be the most cost-effective. We could require certain degrees of control for some categories of plants that would be very cost-effective without requiring those same degrees of control for every plant across the board. Now the negative sides of that option are that there is possible litigation over the pollutants selected; and arguments about whether it is truly a noncriteria or a criteria; pollutant and the probable need to tighten up on our current generic 111d regulations. Our 111d regulations, as they are written today, which were nonhealth-book based pollutants, allow the States considerable ability in deviating from any technology based norm that we lay out under that section.

Moving to another possibility, and that is the definition of modification or reconstruction. It may be possible to modify the definition so that activities at a plant which tend to extend the useful life of that plant or tend to increase the total emissions generated over the total life of that plant could be legally defined as a reconstruction or modification which would, if those activities were undertaken, then cause the plant to be governed by the new source performance standards. Now, the positive aspect of that is that some of our current existing sources which are subject to relatively high emission limits, if they were to extend their useful life substantially, might be brought into the new source performance standards system. That regulatory requirement might cause one of two effects, it might cause a retirement of that facility rather than an extension of its life, or it might cause the retrofit of a source in order to meet the new source performance standard emission limit. The negative side is that there would likely be litigation over any modification of our definition, enforcement might be difficult, the activities that tend to extend useful life are largely a function of what the utility or other source is saying about the effects of those modifications. It might be fairly easy to get into arguments with the sources about these particular physical changes and whether they would have the effect of extending the useful life. If we define the cutpoints, the type of activity that shifts you from one gain to the other too strictly, then you you could wind up imposing some very costly retrofits.

Well there are a number of other items which I would like to identify that are things that the States may be able to do under their current legal authority, at least some States certainly can do some of these things and other States may be able to do more. There are also things that EPA could explore in terms of additional legal authority that might be sought from Congress. One would be some form of emissions cap--some form of maximum emission limit on some category of existing sources, which would be a maximum available in any State in the country and separate from any emission limits that might be calculated by dispersion modeling. The positive aspect of that is that it would address the inequities concern. It could well reduce the emissions substantially from the largest existing sources. It would be quite cost-effective and there is at least an appearance of reasonableness to it. The negative side is that it does raise the potential for disruption of existing coal markets which is a problem which would have to be addressed and resolved and its economic impact might fall on one, two, three, or four States rather heavily and not at all on other States. This would obviously make a political coalition to undertake that, either within the States or nationally, more difficult than something that had a little bit of sacrifice and a little bit of benefit for everybody.

Another possibility would be an emissions cap, a total loadings cap or budget on a Statewide or regionwide basis. This is something that is being discussed in Europe, for example, between the various nations there, many of whom are geographically not all that much larger than some of our States or collections of States. They are discussing total national sulfur budgets, for example. This process would involve giving each State or having a group of States negotiate between themselves a set of total loading targets and each State then would determine the best approach for achieving that target. Two that total loadings target could be anywhere from preserving the status quo to some range of percent reductions, either immediate or phased. The positive aspect of this is that it does allow flexibility within each State to find the most cost-effective way of achieving the target and it does allows some fine tuning geographically in order to try to have the maximum impact on improving the acid rain impacts that we are most immediately concerned about. The negative side is how do you come up with this budget. We do not have an OMB for this process and we do not have someone who has been clearly given the authority to resolve disputes so we do not have an institution that is sitting here today with the legal authority to impose a solution if you do not have agreement among the States. Given what we all know about the adequacy of emission inventories, even in metropolitan areas where they are fairly closely studied, there is some difficulty in determining the compliance with an emission cap particularly since the State that has the obligation to meet a cap is also the institution that has the most information about whether it is or is not meeting that obligation. Finally, these caps may be broader than necessary or optimum, it may be that an air quality control region would be a better basis for a cap or some other geographic subregion that might extend across State boundaries.

Another item which we have mentioned several times already, and other States have mentioned and are considering is mandatory coal washing, which would require all our coals above some sulfur content to undergo a coal washing to a certain percent reduction. This would be economically sound, it might even, in a number of instances, wind up paying the utilities because of possible reductions in transportation costs as well as some operating difficulties associated with burning a poorly washed coal. It would reduce sulfur variability so it would deal additionally with these peaks as well as reducing the total loadings and could get anywhere from 20 to 40% reduction in terms of emission reductions on certain high sulfur coal. The negative features that have to be explored are the adverse secondary environmental effects that might be associated with broad scale coal washing. Coal washing facilities are industrial processes themselves. What are their affluence? What are their externalities, and if broadly done, do we know what they all are? The other feature that we would have to address ourselves to is how do we design the system to avoid fuel switchings that could wind up with more washed coal but not necessarily lower emissions. That is, if plant A switches from a five pound unwashed coal to an eight pound run of the mine coal which is washed to five, we are right back where we started from in terms of total loadings. We may have improved our flexibility in terms of our resource base but we have not directly attacked the total loadings problem.

I will just run through the others in the three minutes I intend to take to finish up on this to keep it to a half an hour. Final opportunity is our taxing schemes--a sulfur tax, an NO_x tax. These are taxes that could be established by Congress or taxes that could be established by State legislatures. They could take on an infinite variety, they could be negotiated through interstate compacts that have equitable taxing schemes to deal with some of these issues, they might allow transfers of burdens across utility systems or across grids in a way that would avoid putting all the economic burden on one utility system or one group of rate payers. They are argued to be quite efficient, flexible, and cost-effective. The negative side is that getting tax schemes through our legislatures, whether they be Congress or the State, go to committees that are not environmental committees and have not been historically favorable to using tax schemes to accomplish these kinds of objectives. We might wind up with a tax scheme that had the appearance of a reform but in fact did not accomplish the intended objective because of some carefully written language which all of us are not expert in understanding.

Another institutional approach, if you will, is one that would require least emissions dispatching rather than least cost dispatching. This could reduce emissions without additional capital investments and might encourage utilities to retire some older, less efficient, higher emitting sources simply because the Utility Commission would be requiring those to be used less and they would be less efficient to keep operating. The negative side of that is that in utility systems that are burning oil and gas you could and probably would lead to an increase in oil and gas use which is something we are trying to avoid. It would most likely increase cost to the rate payer because if least cost and least emissions dispatching did not coincide then least emissions dispatching would be more expensive than the least cost alternative. It would be difficult to monitor because we are dealing with daily operational decisions and it might encounter some of the enforcement difficulties that we felt have always existed with schemes like intermittent controls.

There are other activities that we, in the abatement area, could encourage. Things like the regulatory reform or the State Utility

Commissions that would allow automatic pass through similar to the fuel adjustment clause for emission control costs. This could be used and is something that all of us could try to educate the Public Utility Commission on. Finally we could and we will be communicating with the IRS to encourage favorable tax treatment for the facilities that reduce sulfur but are not located at the fuel consuming facility itself. Right now, if a utility puts a scrubber on, it does get favorable tax treatment. If it uses washed coal it does not necessarily get that and especially if the coal washing facility is not at the utility plant itself.

Well, these are a fairly extended but probably not all comprehensive laundry list of some areas that I think during the rest of the day we would like to have you explore and the format for the rest of the morning will now be to turn to presentations by the States themselves and I would like to have Doug come forward and Walt also wants to make a statement.

Walter Barber: We have a couple of administrative things. We are going to change the order of presentations a little bit. Commissioner English from New Jersey will lead the series of State presentations followed by Jim Hambright, then Bud Hovey, and then Dan Goodwin, to accommodate some schedules. I would like to add one note to Dave's comments, it sounded like an awfully long list. We have an effort going on in the Agency to analyze a subset of alternatives over the next couple of months both in terms of energy environmental impacts and economic impacts to bring into better focus some of the choices. I have been looking at this as what can we do in the near-term, what can we in the mid-term, and what can we do in the long-term. We probably have to carve this problem up into pieces, be they 10% reduction pieces, or 5% reduction pieces. If we wait until we have the perfect solution, the right mix of all of them, to get to the bottom of the problem, we will be into the next decade because we will not have the problem fully identified and analyzed until then. In our discussions today, we ought to start to explore what is the best first step, and then what is the best second step, and if you really need legislation it is probably out at the third step range, assuming that we can do some things in the near-term. Bud, you want to introduce the State speakers?

Dave Hawkins: Walt will now introduce each of the State speakers and the first is going to be Commissioner Jerry English of New Jersey. After I just said Walt will introduce her, I will introduce her. Commissioner English has been able to come down and join us and we want to welcome her from the State of New Jersey. She will make an initial presentation which will then be followed by Jim Hambright. So Commissioner English, welcome.

Commissioner English: Good morning, I think that the first thing we want to dispel is some suggestion that the Environmental Protection Agency is not a group of able people capable of prompt change. By changing the agenda this morning just like that it shows me that they can also change directions and more importantly get lunch together. Obviously, I am going to miss the best part.

My name is Jerry English, I am the Commissioner of Environmental Protection of the great State of New Jersey, also known as the garden state. I would like to thank the Administrator and Mr. Hawkins for providing this forum in response to requests basically from the Northeastern

States who have expressed concern with the acid rain phenomenon and the tremendous social and economic implications that will flow from any solutions or nonsolutions to the problems that you have been talking about. I am now going to apologize in advance. I realize that you have been here already for one day, discussed everything I am going to talk about, but I would like to try and put it, if you will, into some sort of perspective for those of us who must administer the program every day.

The United States, as you have already said, annually discharges more than 50 million tons of sulfur and nitrogen oxides into the air. The pollutants are converted into acids and are causing severe ecological impacts on widespread areas of the environment. This is obviously not just a national phenomena but is also an international phenomena, but again I am certain that you have talked about this already.

When my neighbors in the Adirondacks talk about 90 lakes that are fishless because of the acidic conditions, that only indicates that other areas of the United States such as Northern Minnesota and Wisconsin will be vulnerable to similar impacts. More importantly, I think that the Agency's own research has shown that sulfates and fine particulates emitted by the same processes that contribute to the acid rain problem are severely detrimental to human health and indeed that is really why we are here, I submit. In addition, the yield from agricultural crops and the productivity of forests can be reduced as a result of the direct effects of acids on foliage and leaching from minerals in the soil, as I am certain has been documented in this conference already. In short, we are faced with a severe threat to the delicate ecological balance in large areas of the nation.

The air pollution problems from fossil fuel combustion will be exacerbated by the present push to curb our ravenous appetite for imported oil. Again, another reason why this particular conference is so timely and why the Congress will be paying particular attention, we think, to the problems we are about to address.

For example, a recent evaluation of the Federal Department of Energy plans to convert oil-fired power plants to coal-fired plants indicates that sulfur dioxide emissions to the atmosphere could be increased by as much as 400,000 tons per year in the Northeast alone.

New Jersey is fully committed to President Carter's long-term strategy for reducing our dependence on foreign oil, let there be no mistake about that. As Governor Byrne recently said in his State-of-the-State message, "no more difficult problem faces us, and the nation, than that of unstable energy prices, and unstable energy supplies." Thus our policy decisions are complicated by the tension between our efforts to deal with the acid rain and the national policy to conserve oil by burning coal. In our view this tension makes it all the more important that we develop uniform national guidelines for sulfur dioxide air pollution emissions. Coal conversion must proceed, but this is why we are here, rationally and prudently.

In New Jersey we have adopted a policy of coal conversion in a manner which minimizes the resultant air pollution problem. National guidelines, again, why we are here, are necessary to relieve the pressure on individual States to act on behalf of a local constituency in a manner which is detrimental to regional, national, or even global environmental interests. But let's not kid ourselves. If you try to minimize the expense at this point, the highest and best solution today may well not be the most expensive solution when we look back on the problem from future vantage points.

This conference, we submit, must serve as a springboard for constructive action. It is to be taken jointly by Federal and state governments. Administrator Costle, I pledge to you a very good staff on a day-to-day basis and I am certain that those of the rest of us in the Northeast will do the same, because this problem is not going away. We have long been of the opinion that only cooperation between the States, orchestrated and coordinated by strong Federal policy and leadership, will be effective in combating the effects of acid rain and other problems related to the long distance transport of pollutants.

I am pleased to be attending a conference devoted to these issues; however, I am somewhat puzzled at the state-of-affairs that has led us to the need for such a conference at such a late date.

Despite our knowledge of the severity of this problem and despite the clear energy and economic pressure to worsen the situation here in 1980 we are apparently still in the very early stages of considering how to deal with it. It is certainly not too late, again we submit, to effect policy changes which can reverse a deteriorating situation, but I question whether we in the Northeast can afford continued inaction in the face of documented dangers of the nonpolicy of the past. Thus we applaud President Carter's understanding of the issue at a very important time in the life of the history of EPA, its tenth anniversary in which the President named the acid rain phenomena as one of the preeminent environmental challenges of the decade. We look to this agency which is very distinguished to take up that challenge without delay. But we intend to help.

In order to accomplish this goal, it is necessary to go to Congress to seek legislative changes to the Clean Air Act, and at the same time reexamine the national ambient air quality standards for SO_x to account for the effects of derivative pollutants such as acid rain and sulfates. The route that the Federal government chooses to accomplish this goal is a problem to be resolved again by the Administration, the Congress, and the States together. To be sure, New Jersey and other States will be heard on the issue at it evolves, but our primary concern today is that EPA understand the need for decisive positive action at the Federal level and that such action is imperative. Again, we keep saying without further delay, in Washington, "without further delay" is a term apart, and in the States it takes a little longer.

March 19, before the Senate Subcommittee on Environmental Pollution, Administrator Costle stated that less than one-half of the acid rain, now I am going to get regional on you, that falls on the Northeast is generated there. This observation goes to the very crux of the dilemma about solving the acid rain problem.

Why is that less than 28% of the acid rain in New York and New Jersey according to, again, Doug Costle, generated there? Certainly the meteorological facts of life account for this situation to some extent, but the real dilemma, as we see it, is caused by the inequities that have developed between the States east of the Mississippi with regard to the regulation of SO_2 emissions.

Since the late 1960s, New Jersey and the rest of the Northeast have proven, through rigorous action, that ambient levels of sulfur dioxide can be reduced to healthful levels even in the most urban and industrial settings. And now I get to talk about a place in New Jersey called Bayonne. It is a midsized American city and it is mirrored by cities that are in all the States represented here. It is heavily industrialized, in part, it is typical of the cities that form the heart of our nation's industrial strength. It is rich in ethnic neighborhoods and has a tradition of hard work, and yet it is a city just like cities in every State that could really do with that new economic shot in the arm. The instincts and pressures to lessen standards so that one plant will stay there and not threaten to move out on you is very strong. However, our monitoring stations there offer a model of the dramatic improvement of air quality that has been achieved even in that sort of city.

As the handout shows you, people in Bayonne are supposed to feel better because there has been an 85% reduction in sulfur dioxide pollution in the air since our program began in earnest in late 1966. This is not, as you know better than I, an unusual experience in the environmental improvement in the Northeast. Bridgeport, Connecitcut; Long Island City, New York; Walton, Massachusetts; and countless other cities demonstrate that healthy air and sound economy are not mutually exclusive, and that is really the point of our being here. Such ingenuity and self-reliance have been documented time and time again.

Now I am starting to talk about some important coal issues and I hope you will pay attention, because if we are talking about going to the Congress, you go to the Congress with some friends. We have some very powerful friends in the Northeast-Midwest Congressional Coalition and in the Coalition of Northeastern Governors which has been ably headed by the leadership of Governors Carey, Byrne, and Grasso to name a few. The approach adopted in New Jersey and elsewhere to effect this reduction was to severely limit the sulfur content in fuels burned in our jurisdictions. In light of the economic and technological conditions, again, prevailing at that time, this was a sensible balancing of environmental concerns against social and economic effects.

However, times have changed. The effect of our approach, and increase in our dependence on imported petroleum products has required significant liabilites as a result of the dramatic political and economic changes that have since occurred. But the environmental problems have not gone away. In fact, one reason we are here today, is to consider complications that were not even addressed, they tell me, 15 years ago. I am not sure I believe that. I suspect that everyone knew the problem was there but said let's do one step at a time. That other step's time is now. This challenge must be faced head on now. We cannot simply revert to those more comfortable policies, even though they didn't seem comfortable at the time, of the 1960s in order to reduce our consumption of foreign oil. New Jersey simply cannot relax sulfur in fuel standards or coal burning emission standards to the maximum limit permitted under the national ambient air quality standards because of economic and energy considerations, and in so doing leave the type of legacy to future generations that we all know will be unacceptable.

Our position is that New Jersey and the rest of the Northeast have reached the practical limit as to what can be required of those who would burn coal and high sulfur oil in our States without jeopardizing the health and safety of the citizens. And second, even with existing stringent controls, as the Administrator Costle has pointed out, the acid rain problem will not be resolved in any event by any action taken by the Northeast alone. The time has come to require other jurisdictions outside the Northeast to take the lead in reducing sulfur pollution.

The maps and handouts we have brought, again, graphically illustrate the point. In graph 1, I want you to notice how innocent New Jersey looks. Isn't that wonderful, it is kind of this little place there and it doesn't look so bad. This illustrates the contribution of all States east of the Mississippi to the total SO_2 emissions for the region. I think it makes the point abundantly clear that States outside the Northeast need to reexamine their policy toward SO_2 emissions, and further suggests that one might look to significant reductions in SO_2 atmospheric loading.

Now you are getting to the point where you are starting to argue about the graph, and that is a good sign. Now I have got your attention. For example, an examination of the graph accompanying the all-states graph shows that Ohio is the source of SO_2 emissions which are nearly equal to the total amounts emitted by New Jersey, New York, and Pennsylvania combined. Another approach to quantification, and quantification is the easy way to do this you see, of the equity problem is to examine SO_2 emissions on a per capita basis, and this one they had a lot of fun with. New Jersey continues to look very innocent. This map and the accompanying chart provided to you illustrates that the Northeast today has borne an inequitable share of the responsibility for reducing SO_2 emissions. Did you notice that Mr. Flacke left the room while we talking about New York because his group is kind of innocent too. On the basis of these per capita emissions, the map suggests that those areas colored in red must be required to contribute significantly to the resolution of the acid rain problem.

Now let's get serious, no one in Ohio or Illinois wants New York or New Jersey residents to suffer because of transported air pollutants emitted from their States, and similarly no one in the Northeast wants a single coal miner out of work in Ohio, but that is the reason again that we are here to work on this problem and to cooperate together.

I would like to conclude first of all by saying it would be grossly unfair for us to have come to this conference, to Administrator Costle, and said now here is the problem and you go solve it. I am very pleased that this has been the beginnings of a rational policy put together which I will submit to our Governor as a program that will suggest ways of going about resolving this problem, and again I want to commend New York State for its leadership in thinking about the problem, giving a solution, and then saying at least we have got something here to work from. I can hardly wait until someone explains to me that with coal washing there is also a hazardous waste problem. The whole thing never ends, but we all understand that, but how sensible an idea coal washing seems to me to be. We have a challenge again about sharing these problems equitably and understanding the costs of what we are talking about. I think that you have, in the past two days, discovered that the technology has been there for a long time. Much more difficult will be the question of how to pay for it, how to develop the constituency that will ensure that this administration and this agency has all the tools that it requires in order to solve the problem. That will be a tough fight. It is one that I certainly can pledge to join in, and I say one thing to you, because I did not ask for it to rain today, however, I want you to look closely at the Washington Monument when we get through. It is a symbol of our national pride and it is made of marble. A substance particularly susceptible to acid rain. If the Washington Monument begins to look a little funny or somewhat the worse for wear, it is because we did not do our job right here today. Thank you.

New Jersey Department of Environmental Protection

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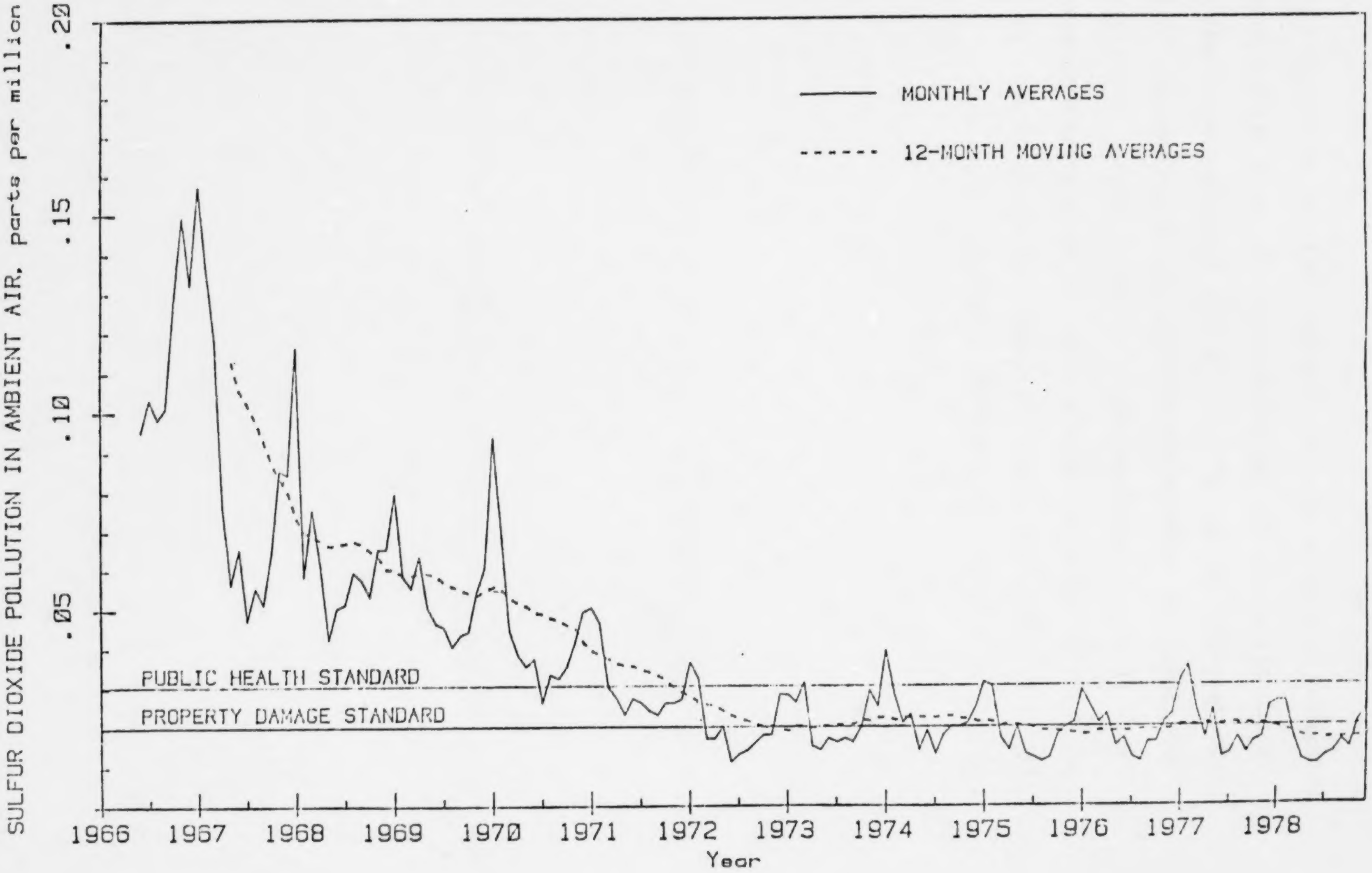
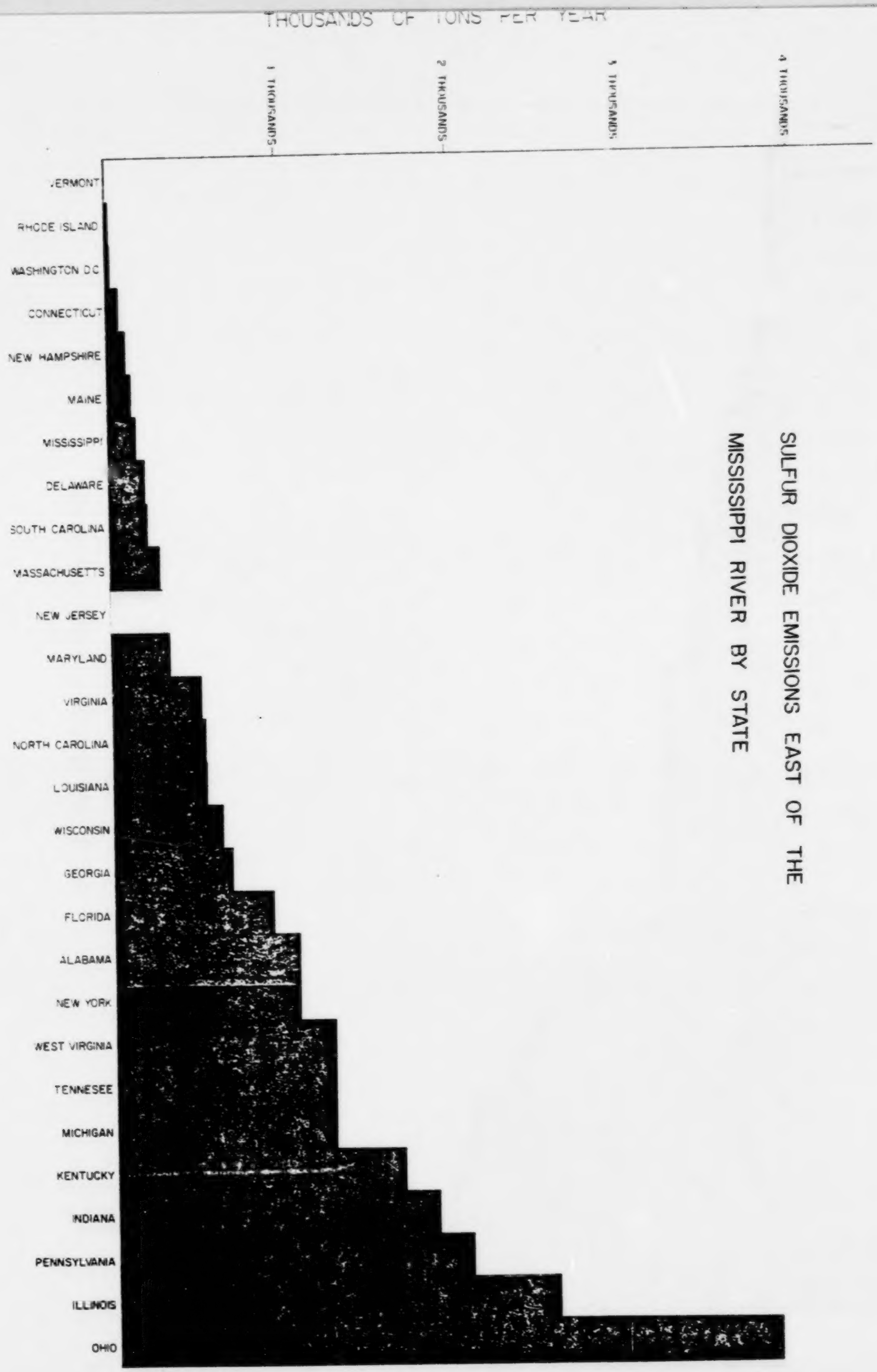
SULFUR DIOXIDE AT BAYONNE CONTINUOUS AIR MONITORING SITE

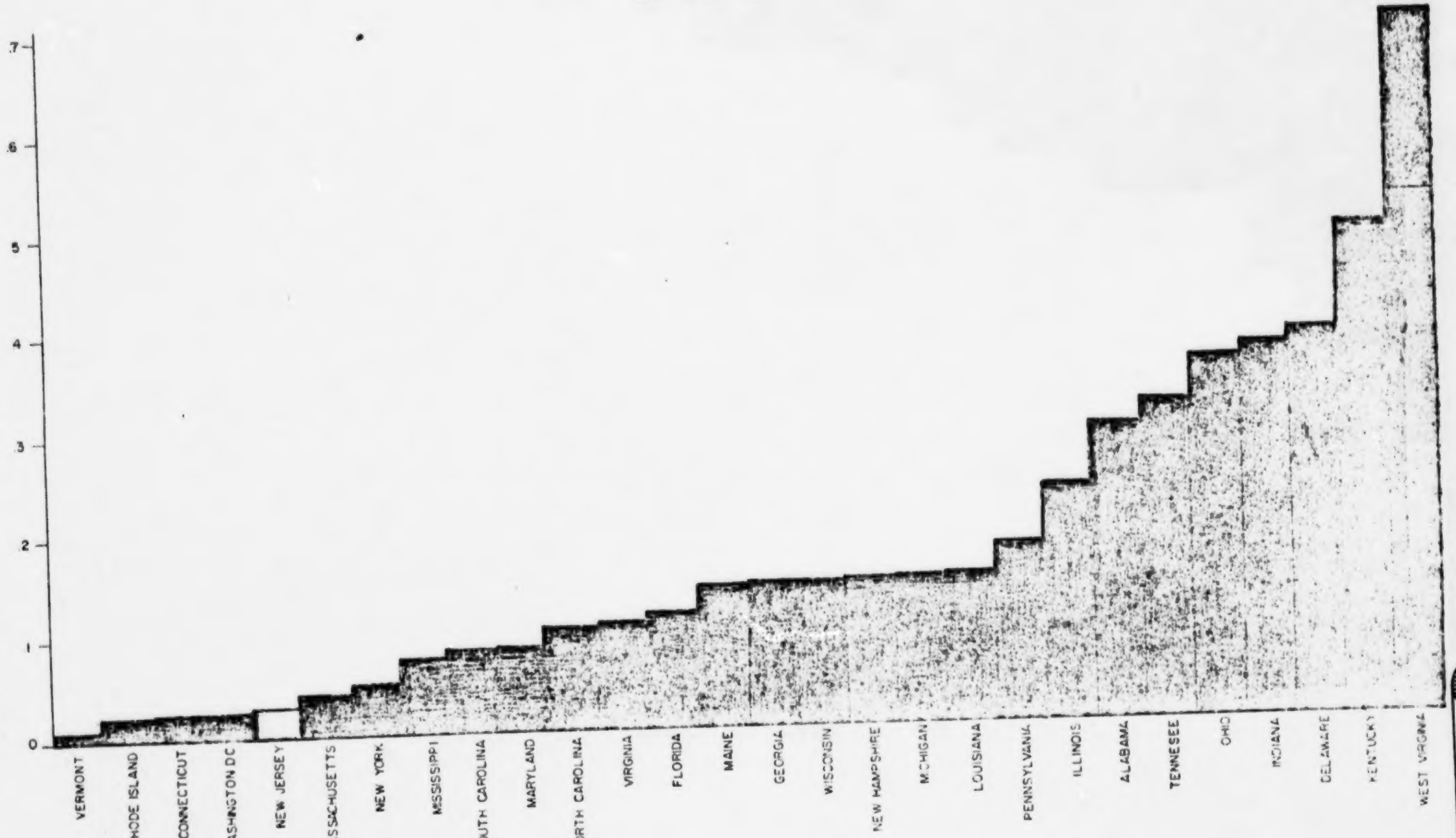


THIS CHART REPRESENTS A SULFUR DIOXIDE POLLUTION REDUCTION OF 85.2 PERCENT.


SULFUR DIOXIDE EMISSIONS EAST OF THE MISSISSIPPI RIVER BY STATE

SOURCE: NATIONAL EMISSIONS DATA SYSTEM, 1975

PER CAPITA SULFUR DIOXIDE EMISSIONS
EAST OF THE MISSISSIPPI RIVER
BY STATE



SOURCE: U.S. CENSUS BUREAU, 197[illegible]
NATIONAL EMISSION DATA
SYSTEM, 197[illegible]

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Mr. Hawkins: Thank you, Commissioner English. Commissioner English relieved some of the formality in the session so far, and I think that it will be important for us to get out of the lecture mode and into the discussion mode as soon as possible, not to cut off Jim's speech but we aren't going to get very far if we only listen. People ought to be working on questions, comments, and reactions now so that we can proceed after the formal presentation with some useful debate.

Jim Hambright: We do not know what the acid rain problem is or may be. We do not have enough data. We have not explored the phenomena enough. We believe that it may be a serious problem and as more information is developed we will be able to explore the scope of that problem. Our initial concern, which we brought to EPA, was with a certain amount of inequities that are occurring because of long-range transported air pollutants, and their effect on our State in making it more difficult for us to achieve attainment in nonattainment areas, and in using our increments in the attainment areas where we are working under prevention of significant deterioration.

I have a series of overheads which will, to some extent, show our concern and what we recognize as a problem which we believe that as a State, alone, we cannot address. We do not have the legal authority to control anything that transpires beyond our boundaries, and we have to look to the Federal government for aid and assistance in these area. Could I have the first slide, please. All right, the data that we are working from here is specifically from coal-fired electric generating plants. This shows the generation in millions of megawatt hours, and the percent total of generation for the States listed on the left.

Next slide, this chart depicts the sulfur dioxide in thousands of tons a year again specifically related to coal-fired plants, and the percentages of total emissions are on the right.

Next slide, this chart shows the pounds of sulfur dioxide emitted per megawatt hour generated from the coal-fired power plants by the respective States. A lot of this data is self explanatory, I am just bringing it to your attention, you can look at it and evaluate it as you may.

Next slide, this is a weighted sulfur dioxide emission from the coal-fired power plants in the respective States, this takes the megawatt capacity times the emission standard accumulated for all the plants in the respective States divided by the total megawatt hour generating capacity, which gives you effectively in pounds per million Btu the weighted standard for the respective States now in place according to the State implementation plans.

Next slide, this is one of a series of overheads. It shows the emission limitations in pounds per million Btu for the respective generating stations, each dot represents a generating station. The red for this series is all those plants which have emission standards greater than the 6 pounds per million Btu. This overlay shows all plants with emissions standards from 4 to 6 pounds per million Btu. The next overlay brings in the power plants with the emission standard of from 2 to 4 pounds per million Btu.

Next overlay. Here we have the plants which fit in from 0 to 2 pounds per million Btu, again, this gives some feel for the various emission standards in place throughout this region of the country and the area of some particular interest to us is the entire Ohio River Basin Power Generating Area.

Next slide, this particular slide lists specific emission standards in place for power plants through the Ohio, West Virginia, Pennsylvania region, all of the Ohio River Valley Basin Area. This picks out those specific plants in this fairly narrow geographical area. The numbers are in pounds of sulfur oxide per million Btu limitations.

Next slide, I bring this to your attention because we believe that it points to a serious problem. We understand that EPA believes that the oil backout, the coal conversion program, will increase sulfur dioxide emissions in the order of 250 to perhaps 400 thousand tons in the Northeast. They have expressed their concern over that and I can understand and sympathize with their concern. However, during the past 12 to 15 months, EPA has considered relaxation of existing SIP standards for the power plants listed on this particular overhead. Some of these have been approved, some are in the process of being approved, and one, at least the Cammer Plant, is being contemplated by the State but has not yet been brought to EPA. The total effort, or the total result of these considerations and actions by EPA results a 759,000 ton per year of sulfur oxide relaxation or extra emissions over what the SIP would allow. This we believe is of significance and if we are going to be serious about addressing long-range transport of pollutants, acid rain or what have you, I believe the Agency must give much more serious consideration to the relaxations which they are allowing. Granted those relaxations may be under the province of the existing Clean Air Act but they are exacerbating a problem.

Next slide, we recognize this problem not as an acid rain problem, we recognize it as a sulfur dioxide and as a total suspended particulate problem in the form of sulfate. These isopleths drawn through Western Pennsylvania show the impact of sulfur dioxide in micrograms per meter annual average which are modeled by EPA's model, by an EPA contract to Cramer, modeled on the basis of emission sources in Ohio and West Virginia which are in compliance with the SIP existing in those areas. Those emissions result in a nonattainment area in Pennsylvania 90 micrograms per cubic meter in the small area in the extreme Western part of the State, and they result in the series of isopleths from 60, 40, 20, 15, out to 10 micrograms per cubic meter impact on Pennsylvania in an area where we can ill afford that impact. The Pittsburgh metropolitan area, the Beaver Valley industrial area, and the Monongahela Valley industrial area. These impacts are caused by pollutants over which we have absolutely no control, they cause us, in some areas, nonattainment where we could be in attainment and where they do not cause nonattainment they are seriously erroding our ability to develop and attract industry because our prevention of significant deterioration increments are devastated. This is a modeled result. In addition to this modeled result, our monitors placed on the extreme Western edge of Pennsylvania have in the past five months recorded two instances of violation of the 24-hour standard. We have recorded an instance of 389 and 455 micrograms per cubic meter, 24-hour violations in an area where we have what amounts to no sources. These occurred during air stagnation inversion periods when the wind direction, such wind as there was, was moving into the State from the West through the Southwest quadrant.

Next slide, previously I have been speaking to the sulfur oxide problem, I would like to move on to the sulfate problem, again, which impacts our ability to achieve our total suspended particulate ambient standards. This is the sulfate episode done by the OBERS study in 1974. It shows how the sulfate increased through this area of the country and pretty much follows the power generating complex up the Ohio River Valley area with a cascading effect into Pennsylvania, New York, and the New England States. The next slide shows what the air mass trajectory are during this period of time and shows how these air mass trajectories tend to move pollutants up the Ohio River Valley area into the Northeast.

Next slide, this is Pennsylvania monitoring results. These are arithmetic annual averages of sulfate. This is sulfate recorded in the Western part of Pennsylvania. Here it is 16 to 15, and down at the lower end, it is 16 to 20 micrograms per cubic meter. We believe that at least 80% of this is advected pollution. Again, sulfate pollution over which we have no control, and which can constitute as much as 20 to 25% of the annual average which we are expected to achieve. We have no control over it, but in some instances it takes us from attainment to nonattainment and in other areas it is certainly impacting our prevention of significant deterioration increments.

The next slide shows some 24-hour maximum figures, as much as 60 micrograms per cubic meter, in a relatively rural area of the State. These again are 24-hour sulfate concentrations much of which we cannot control and really cannot do anything about.

Next slide, this shows that over the last 6 years, in the Beaver Valley, a heavily industrialized area North of Allegheny County. To show how the total suspended particulate matter has declined over those years from something on the order of 120 to 130 down to about 80. During that same period of time, the bottom line, sulfate as a percent of total suspended particulate matter, has shown the following curvature, indicating fairly clearly that, in fact, we have reduced total suspended particulates significantly but that the sulfate is staying relatively the same. The programs which we have implemented to reduce particulates have been effective but the advected pollution is beyond our control on the basis of local enforcement efforts.

Next slide. This again is to show the projection of sulfate impact on the Northeast for the next decade. Presumably, if things go on the way they are and as we have more coal conversion and perhaps no better control we will have increasing amounts of sulfate as shown on this map, up to 29 to 30 micrograms per cubic meter. A potential significant impact which would be very difficult to handle economically and developmentally in the Northeast.

Next slide. This shows deposition of sulfate from the national atmospheric deposition program. This shows where some of the concentrations are, and I will bet that North Carolina did not know that they were a potential hot spot. This is relatively recent data, and again it is not our data, it is national data.

Next slide. This is probably a set you have seen before showing the increase in the acid rain impact in the Northeastern part of the State from 56 through 76 showing how the area is expanded and again I cannot speak to the way in which this particular data was developed. It is not our data, it is Federal or national data.

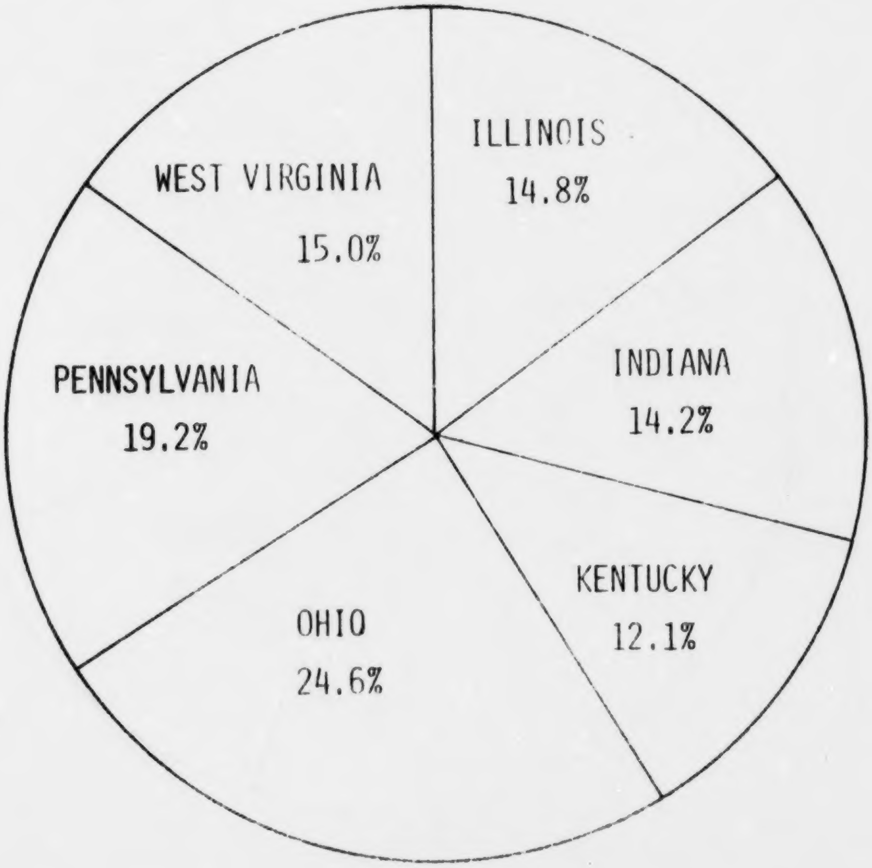
Next slide. This one is to speak again to the problem of the utility coal-fired power plants. This is just a "for instance" and it is not specifically a recommendation but just to show that if all the States indicated, reduced their utility emissions to the same level at which the utilities are controlled in Pennsylvania, the total mass emission rate reduction would be somewhat in excess of 11.7 million tons of sulfur oxide per year.

Now let's go off the slides, please. I think that we have recognized this as a problem which we cannot control, I think we can demonstrate with something a little harder in the way of information than modeled results that it is a problem that we cannot do anything about. We believe that there has to be a regional approach to this problem. We think that a regional approach has to be done through some mechanism controlled by the Federal government since the individual States cannot really approach or address these problems of interstate impact. We believe coal washing is a technique which would produce reductions of maybe 10% to 15%. It is something which would be relatively cost effective and which should be considered. We also believe that the Orsanco area or the OBERS study group has a pretty good handle on data and information in the Ohio River Valley Area. Their studies could be expanded to show need for the Federal government to take a regionalized approach in this area to establish perhaps more equitable control efforts, or to provide for mass emission reductions in this area which would benefit not only our particular problems that I have addressed, but also the total problem of the acid rain throughout the Northeast.

I do not know that I have heard anything here today that has made me tremendously optimistic, but I think we should all continue to work toward a solution to the problem that we have identified. In Pennsylvania, New Jersey, and Delaware, we developed a regional approach to the sulfur oxide problem. This was done in cooperation and coordination with the Federal government. It was not done under any Federal law, but it was done as a cooperative effort. However, that cooperative effort was pushed pretty strongly by the Federal government and I believe that we need that type of a catalyst to get the thing going and to achieve some of the goals that we are trying to get to. Thank you very much for your time.

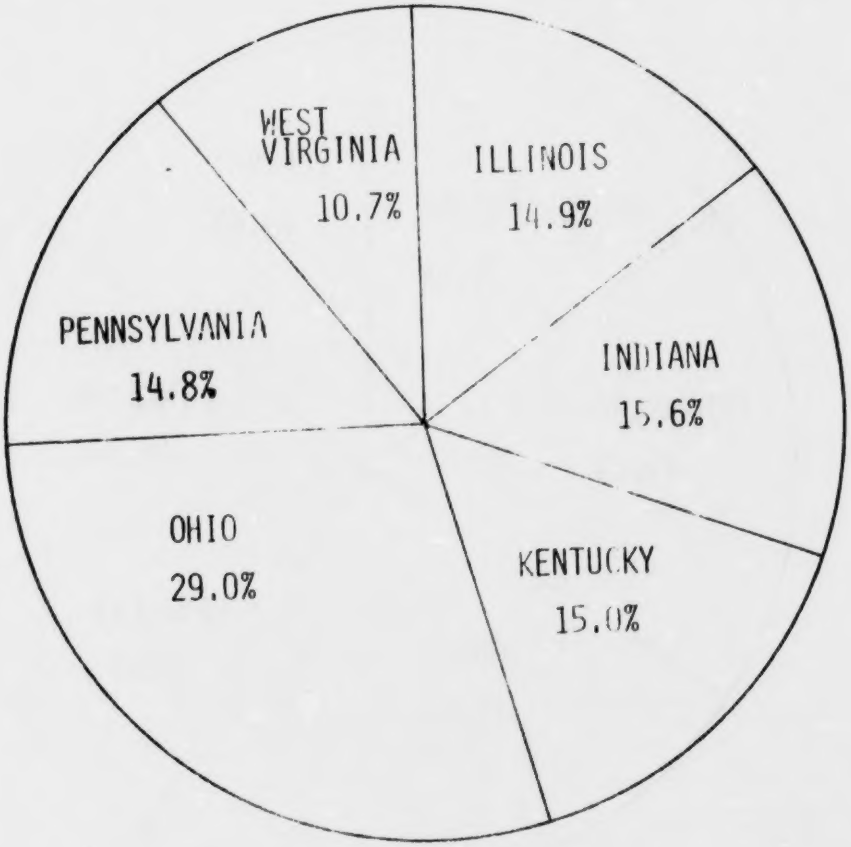
ELECTRIC GENERATION - COAL FIRED PLANTS - 1977

State	Generation 10^6 MWH	Percent Of Total
Illinois	65.0	14.8
Indiana	62.0	14.2
Kentucky	53.2	12.1
Ohio	107.7	24.6
Pennsylvania	84.1	19.2
West Virginia	65.9	15.0
	437.9	100.0

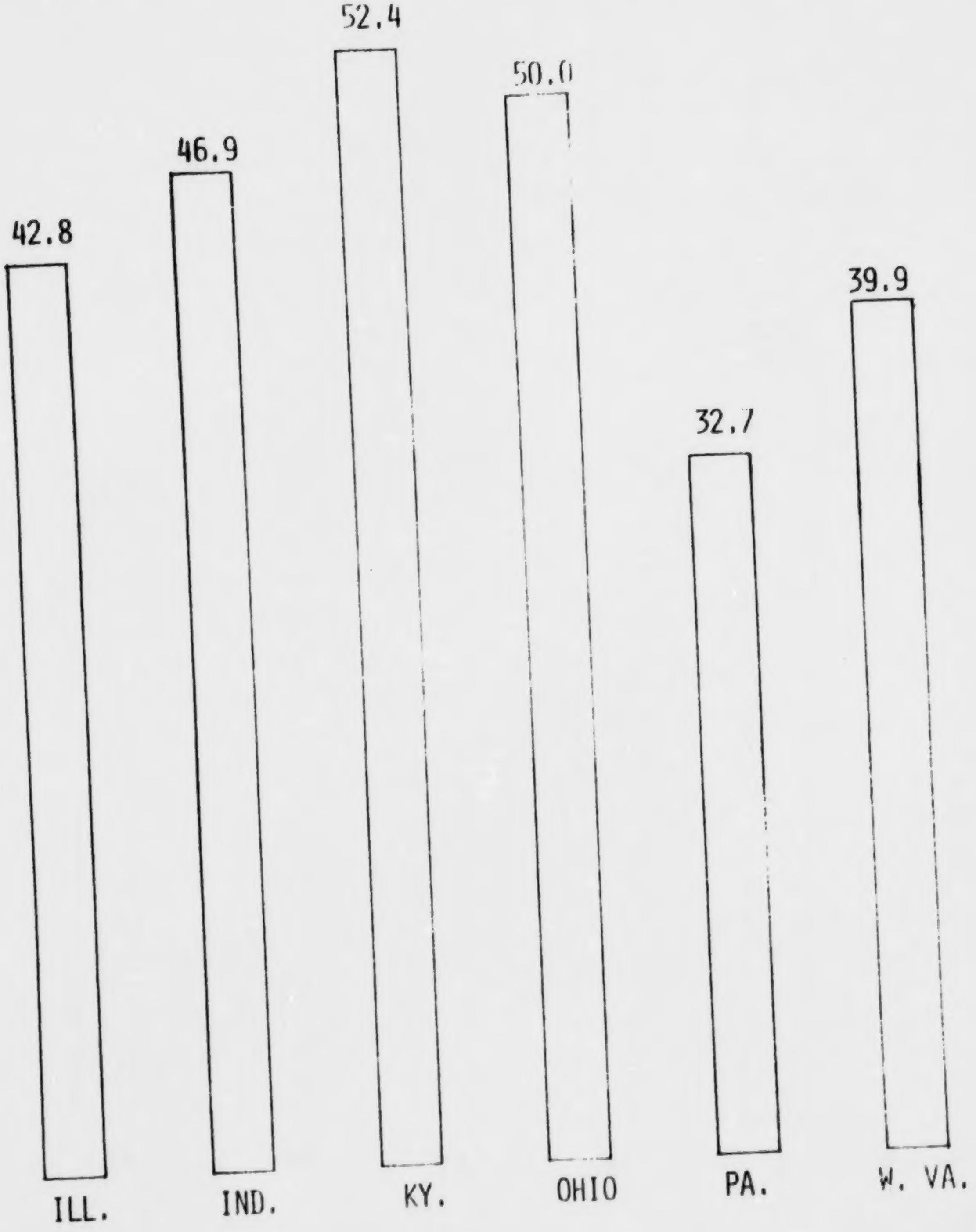


ESTIMATED SO_2 EMISSIONS - COAL FIRED PLANTS - 1977

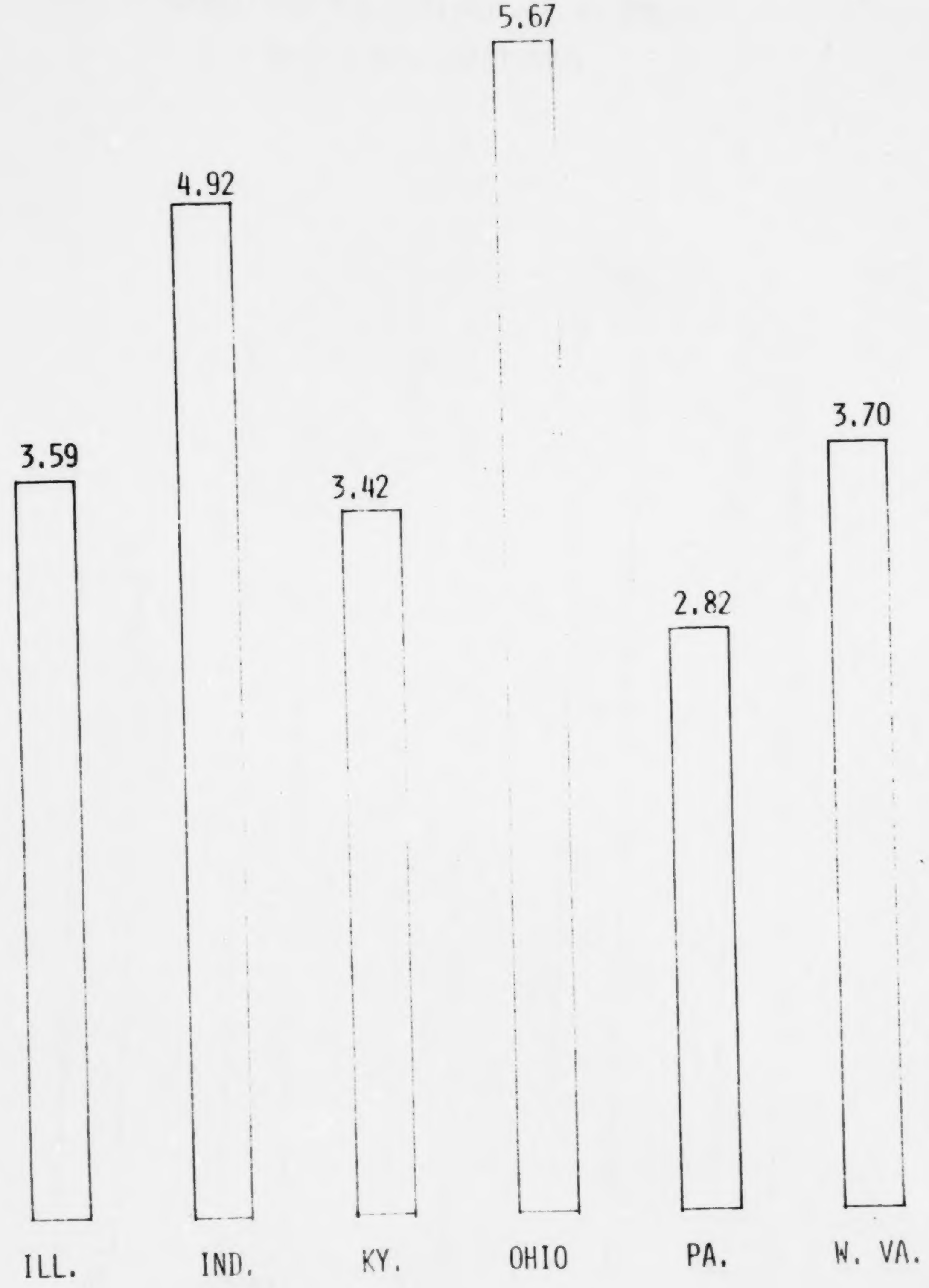
State	SO_2 Emissions 10^3 Tons/Year	Percent of Total
Illinois	1,389	14.9
Indiana	1,454	15.6
Kentucky	1,392	15.0
Ohio	2,695	29.0
Pennsylvania	1,375	14.8
West Virginia	992	10.7
	9,297	100.0



POUNDS OF SO_2 EMITTED PER MWH GENERATED
COAL FIRED POWER PLANTS

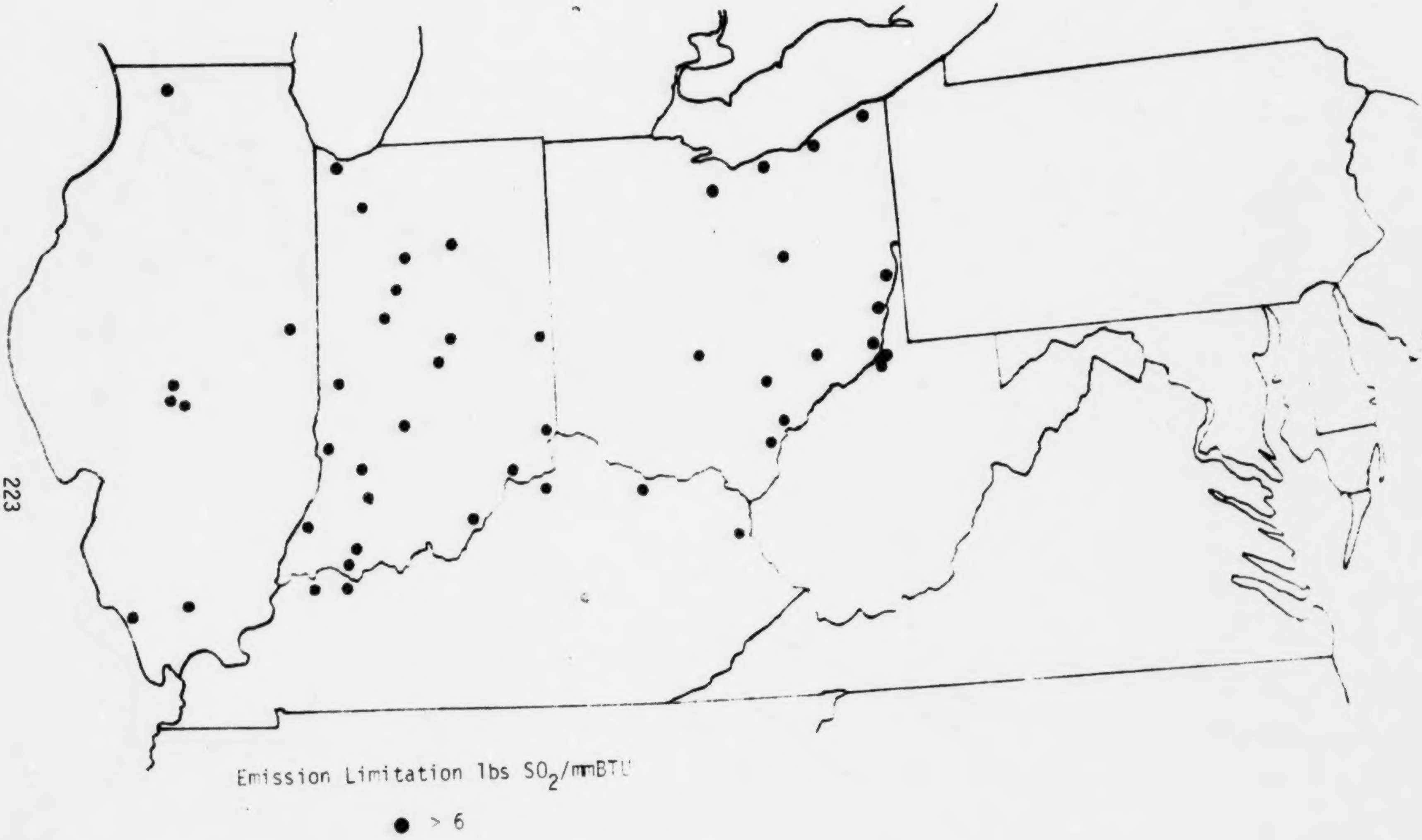


WEIGHTED SO_2 EMISSION LIMITATIONS
COAL FIRED POWER PLANTS (EXCLUDING NSPS SOURCES)

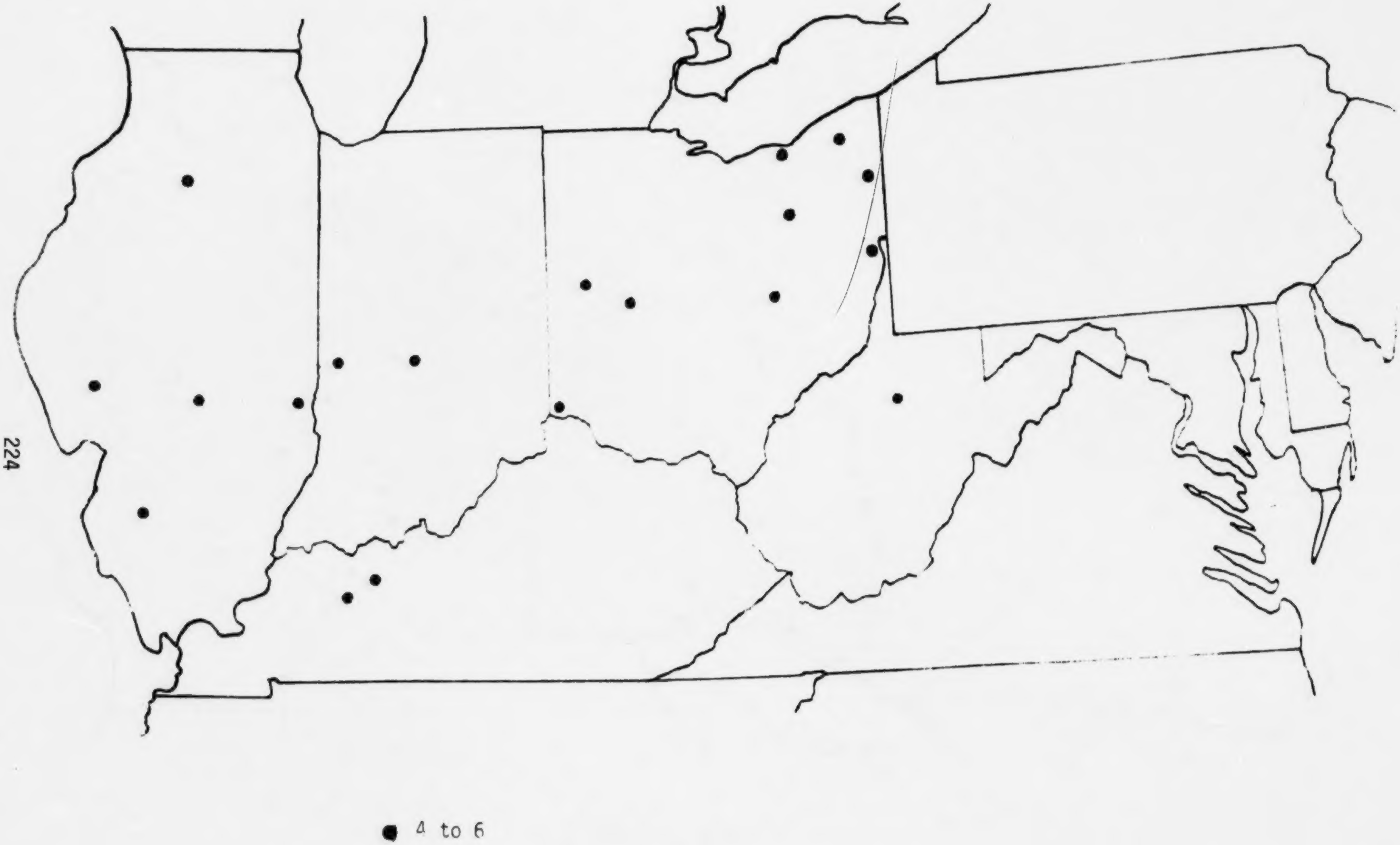


LOCATION OF POWER PLANTS WITH SO_2 EMISSION STANDARD

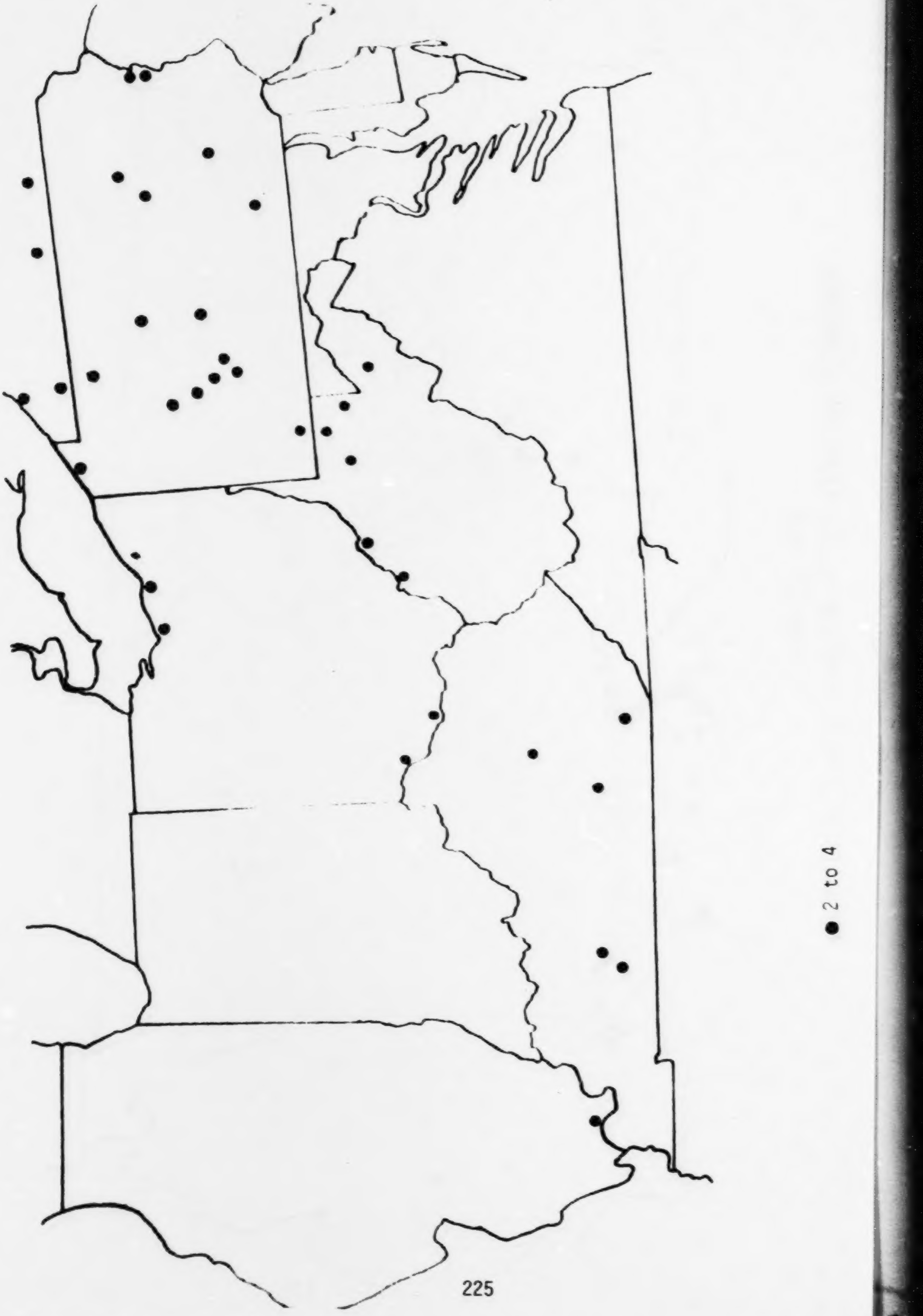
> 6 LBS/10^6 BTU


Emission Limitation lbs SO_2/mmBTU
● > 6

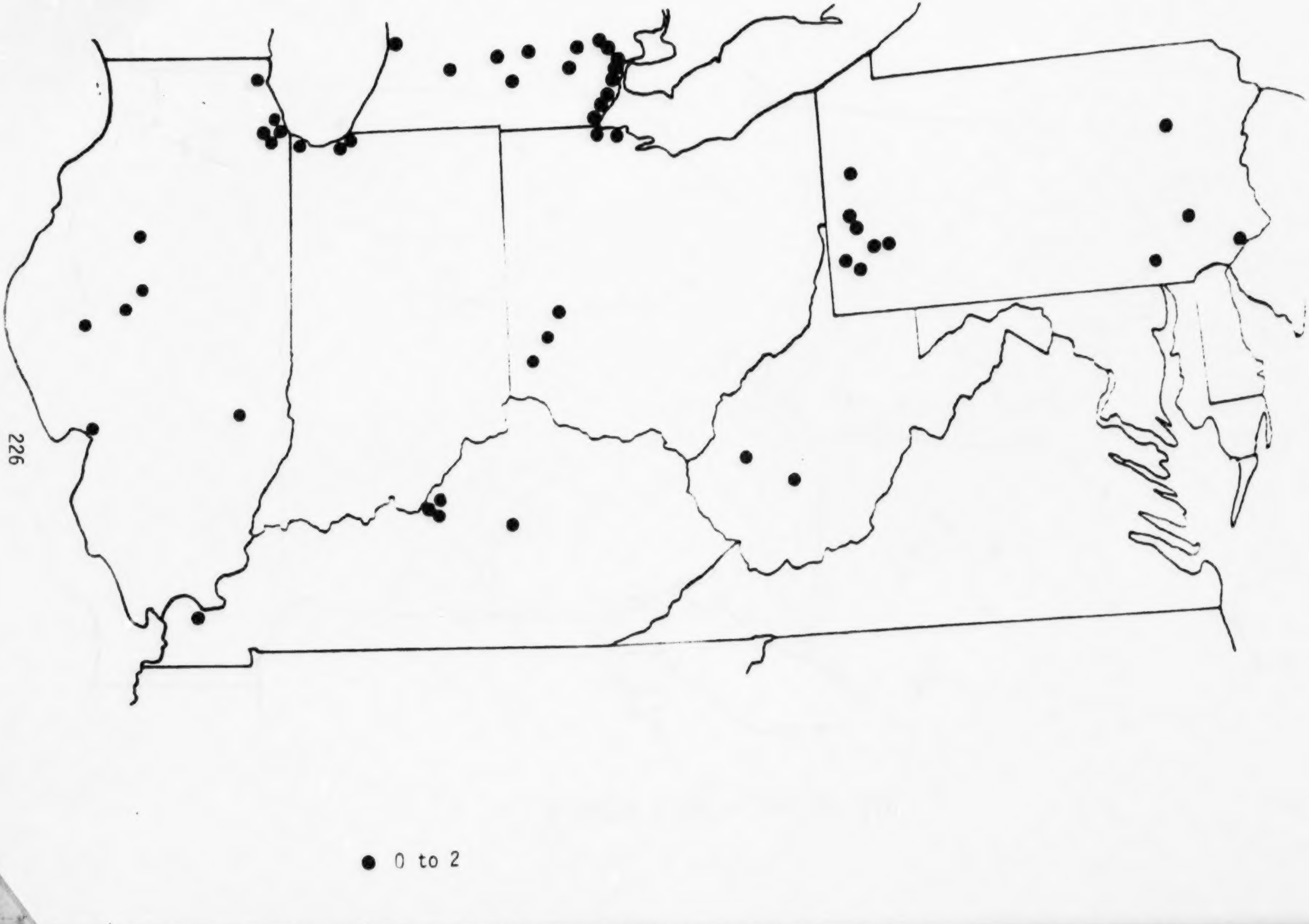
LOCATION OF POWER PLANTS WITH SO_2 EMISSION STANDARDS BETWEEN 4 AND 6 LBS/10^6 BTU

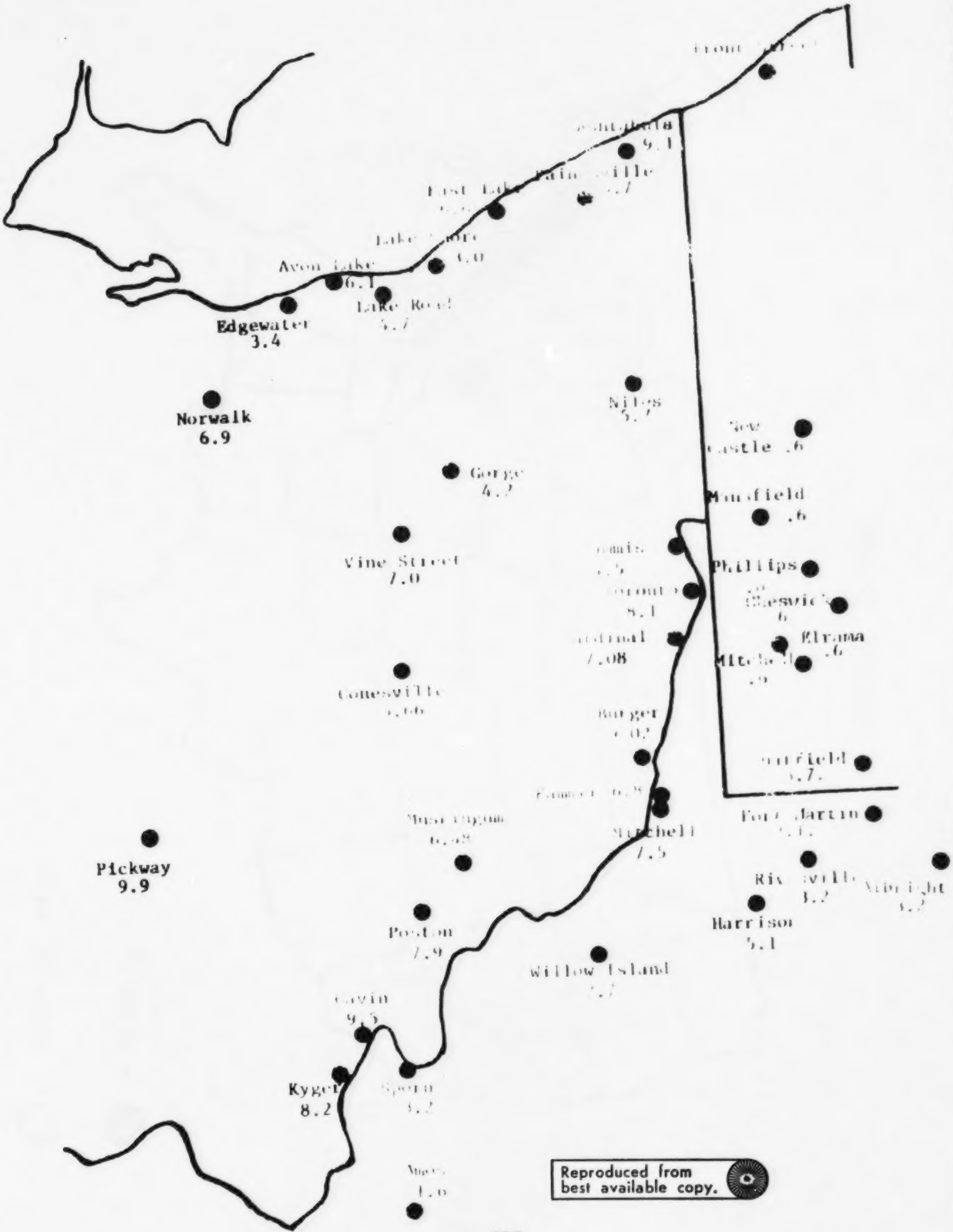


BETWEEN 2 AND 4 LBS/10^6 BTU



LOCATION OF POWER PLANTS WITH SO_2 EMISSION STANDARDS
< 2 LBS/10^6 BTU




Ashtabula
9.1
East Lake
Painesville
Lake Shore
6.0
Avon Lake
6.1
Lake Road
5.7
Edgewater
3.4
Norwalk
6.9
Niles
5.7
New
Castle .6
Gorge
4.2
Mansfield
.6
Vine Street
7.0
Phillips
Toronto
8.1
Cheswick
6
Elrama
.6
Mitchell
7.08
Conesville
Burger
Mitchell
7.5
Muskingum
Pickway
9.9
Fort Martin
Rivesville
3.2
Albright
Harrison
5.1
Poston
7.9
Willow Island
Gavin
9.5
Kyger
8.2
Sporn
Ames

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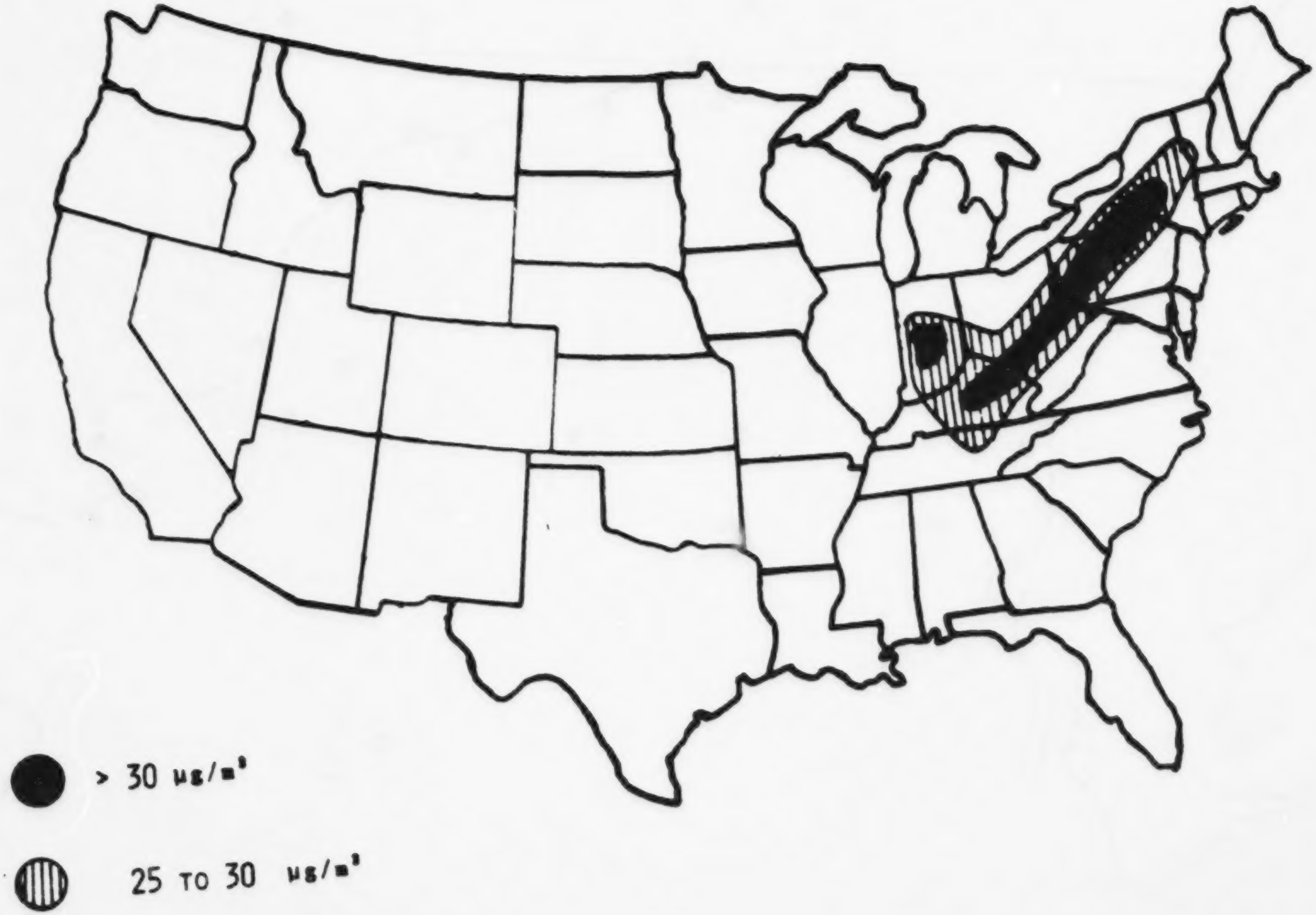
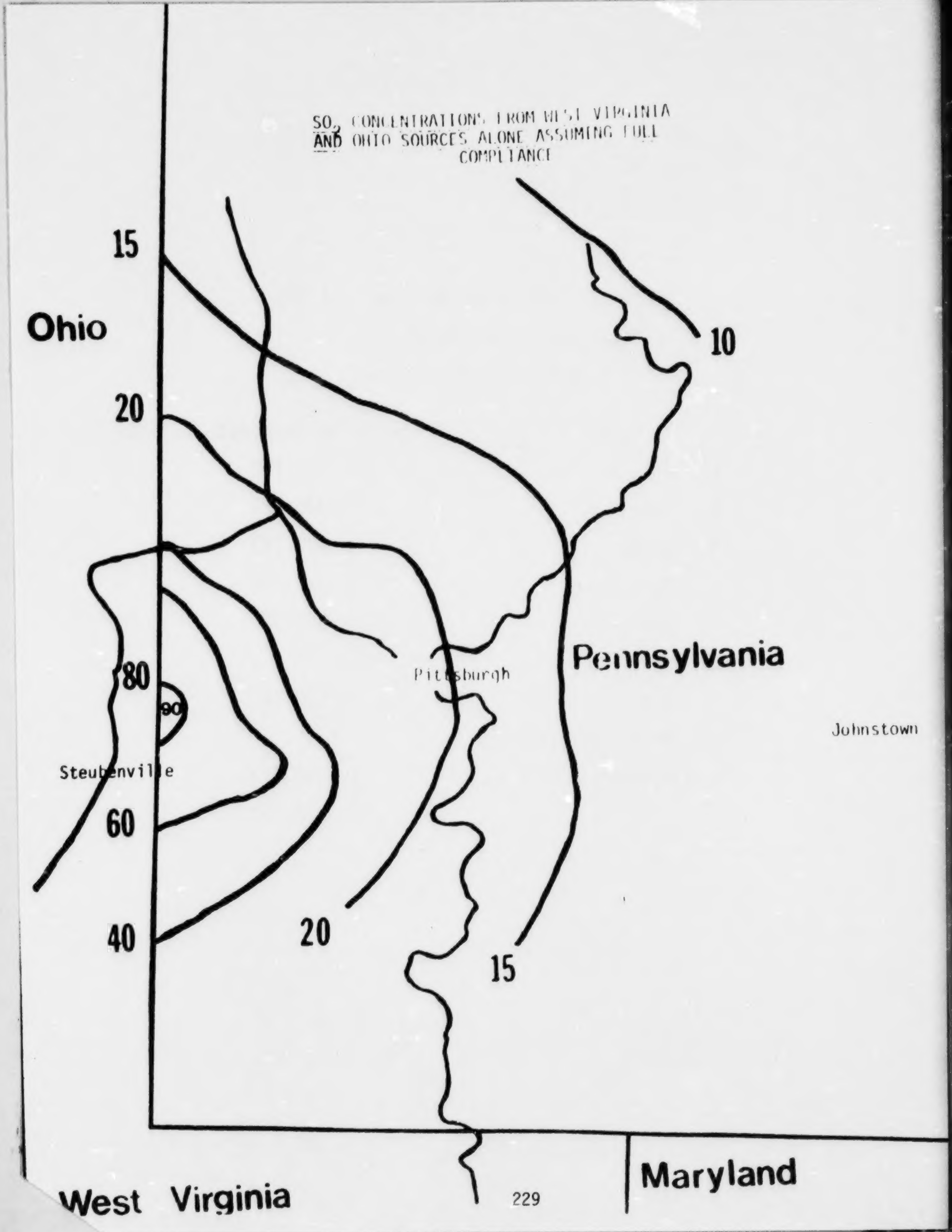
SULFATE EPISODE


● > 30 μg/m³
▥ 25 TO 30 μg/m³



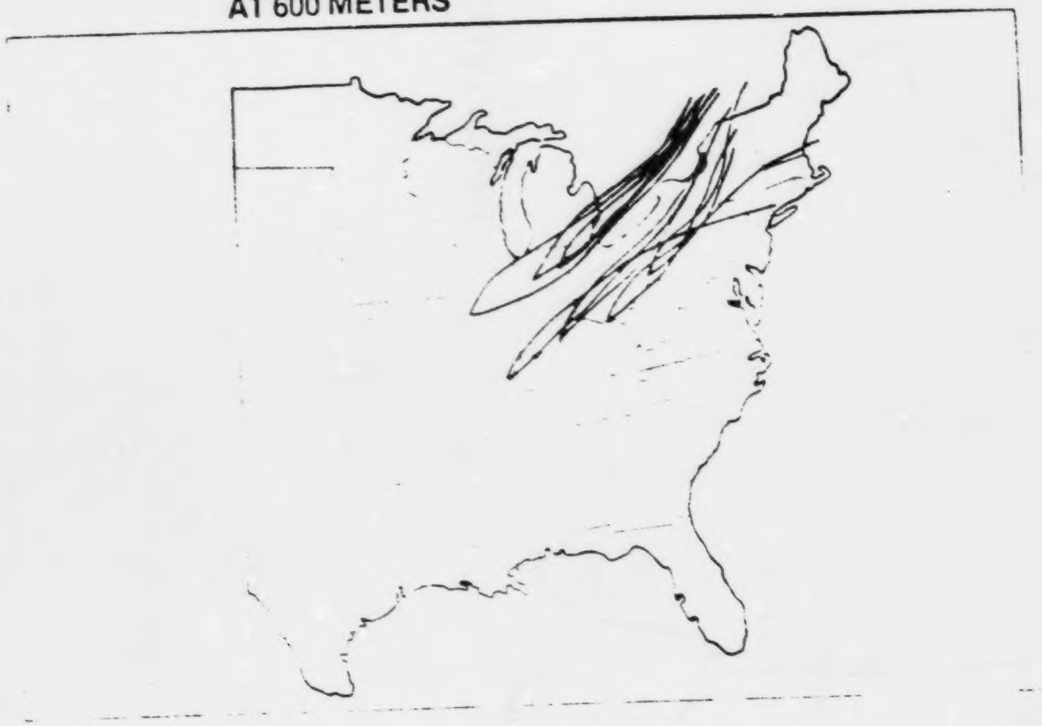
SO_2 CONCENTRATIONS FROM WEST VIRGINIA AND OHIO SOURCES ALONE ASSUMING FULL COMPLIANCE

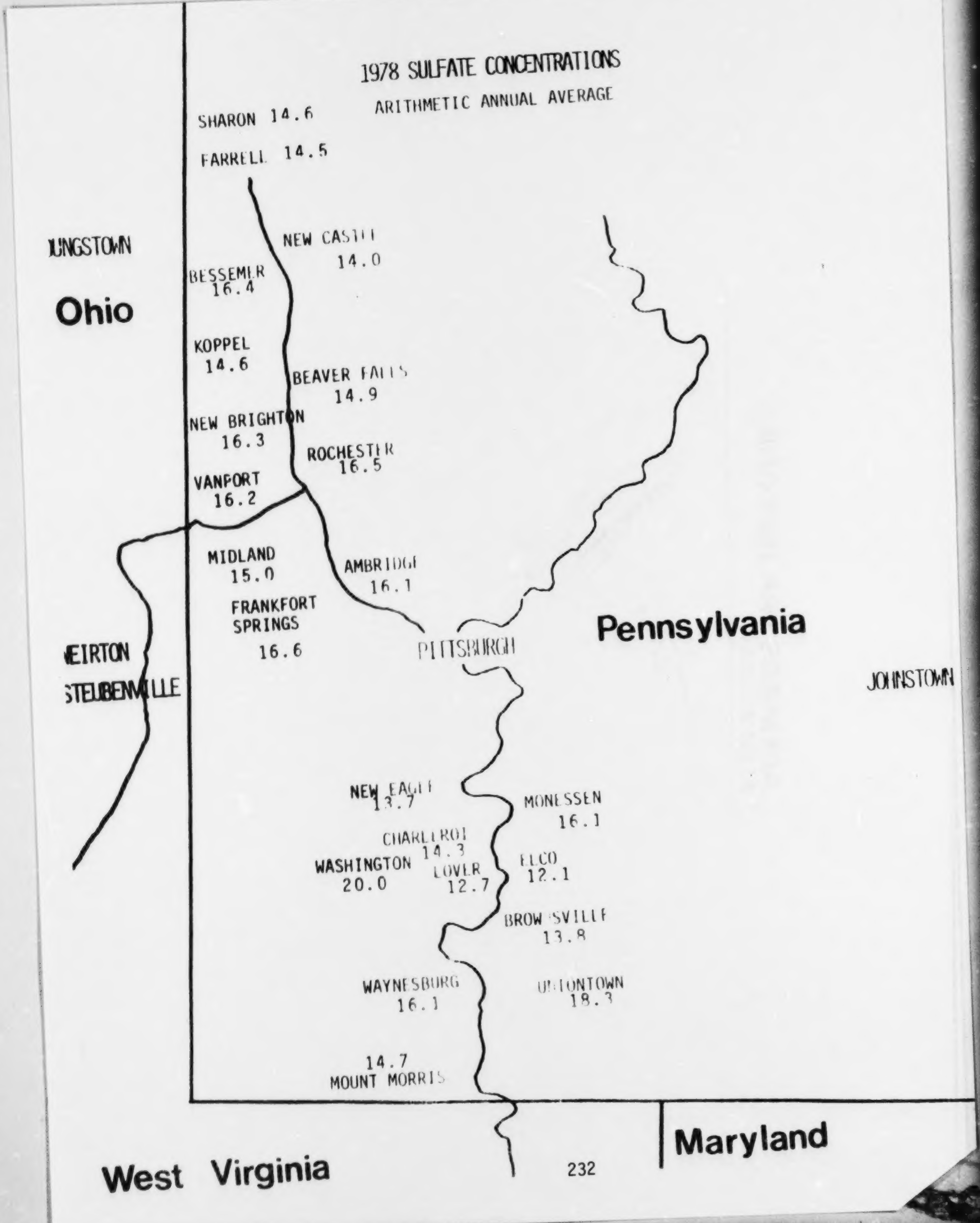
15
10
Ohio
20
80
90
Pittsburgh
Pennsylvania
Johnstown
Steubenville
60
40
20
15
West Virginia
Maryland

ALLOWABLE EMISSION INCREASES IN SO_2 RESULTING FROM EPA PROPOSED OR APPROVED RELAXATIONS

	PLANT	EMISSION INCREASE
1.	MITCHELL	162,000 TPY
2.	HARRISON	93,000 TPY
3.	KAMMER	66,800 TPY
4.	AVON LAKE	127,900 TPY
5.	EASTLAKE	280,900 TPY
6.	BAYSHORE	
	ACME	5,500 TPY
	WATER STREET	
7.	POSTON	14,000 TPY
		759,000 TPY

AIR MASS TRAJECTORIES
AT 600 METERS





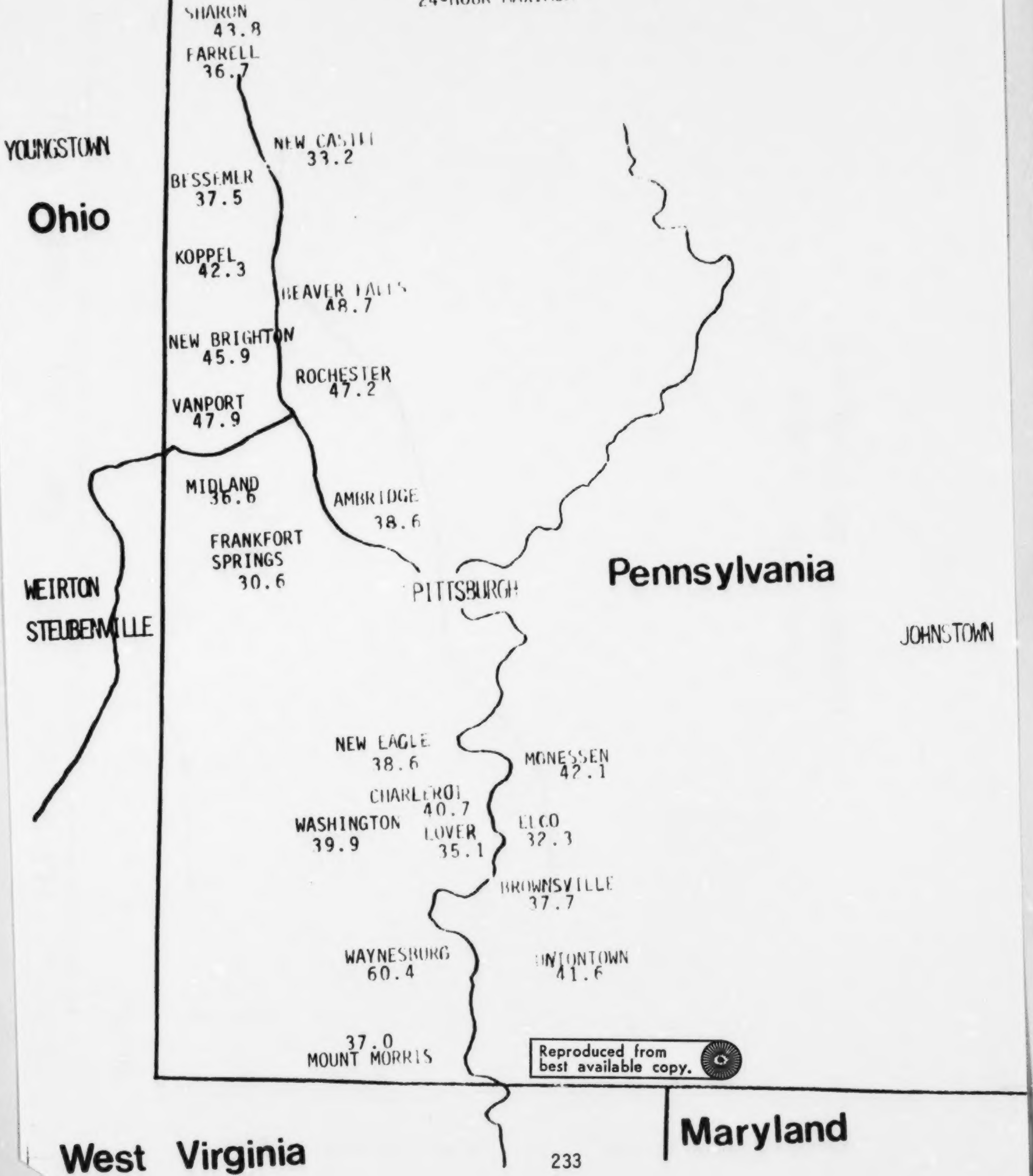
1978 SULFATE CONCENTRATIONS

ARITHMETIC ANNUAL AVERAGE

SHARON 14.6
FARRELL 14.5
UNGSTOWN
NEW CASTLE
14.0
BESSEMER
16.4
Ohio
KOPPEL
14.6
BEAVER FALLS
14.9
NEW BRIGHTON
16.3
ROCHESTER
16.5
VANPORT
16.2
MIDLAND
15.0
AMBRIDGE
16.1
FRANKFORT
SPRINGS
16.6
PITTSBURGH
Pennsylvania
EIRTON
STEUBENVILLE
JOHNSTOWN
NEW EAGLE
13.7
MONESSEN
16.1
CHARLEROI
14.3
WASHINGTON
20.0
LOVER
12.7
ELCO
12.1
BROWNSVILLE
13.8
WAYNESBURG
16.1
UNIONTOWN
18.3
14.7
MOUNT MORRIS
Maryland
West Virginia

1978 SULFATE CONCENTRATIONS

24-HOUR MAXIMUM



SHARON 43.8
FARRELL 36.7
YOUNGSTOWN
Ohio
NEW CASTLE 33.2
BESSEMER 37.5
KOPPEL 42.3
BEAVER FALLS 48.7
NEW BRIGHTON 45.9
ROCHESTER 47.2
VANPORT 47.9
MIDLAND 36.6
AMBRIDGE 38.6
FRANKFORT SPRINGS 30.6
WEIRTON
STEUBENVILLE
PITTSBURGH
Pennsylvania
JOHNSTOWN
NEW EAGLE 38.6
MONESSEN 42.1
CHARLEROI 40.7
WASHINGTON 39.9
LOVER 35.1
ELCO 32.3
BROWNSVILLE 37.7
WAYNESBURG 60.4
UNIONTOWN 41.6
37.0 MOUNT MORRIS
West Virginia
Maryland

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HISTORICAL TSP AND SULFATE DATA
BEAVER VALLEY AIR BASIN

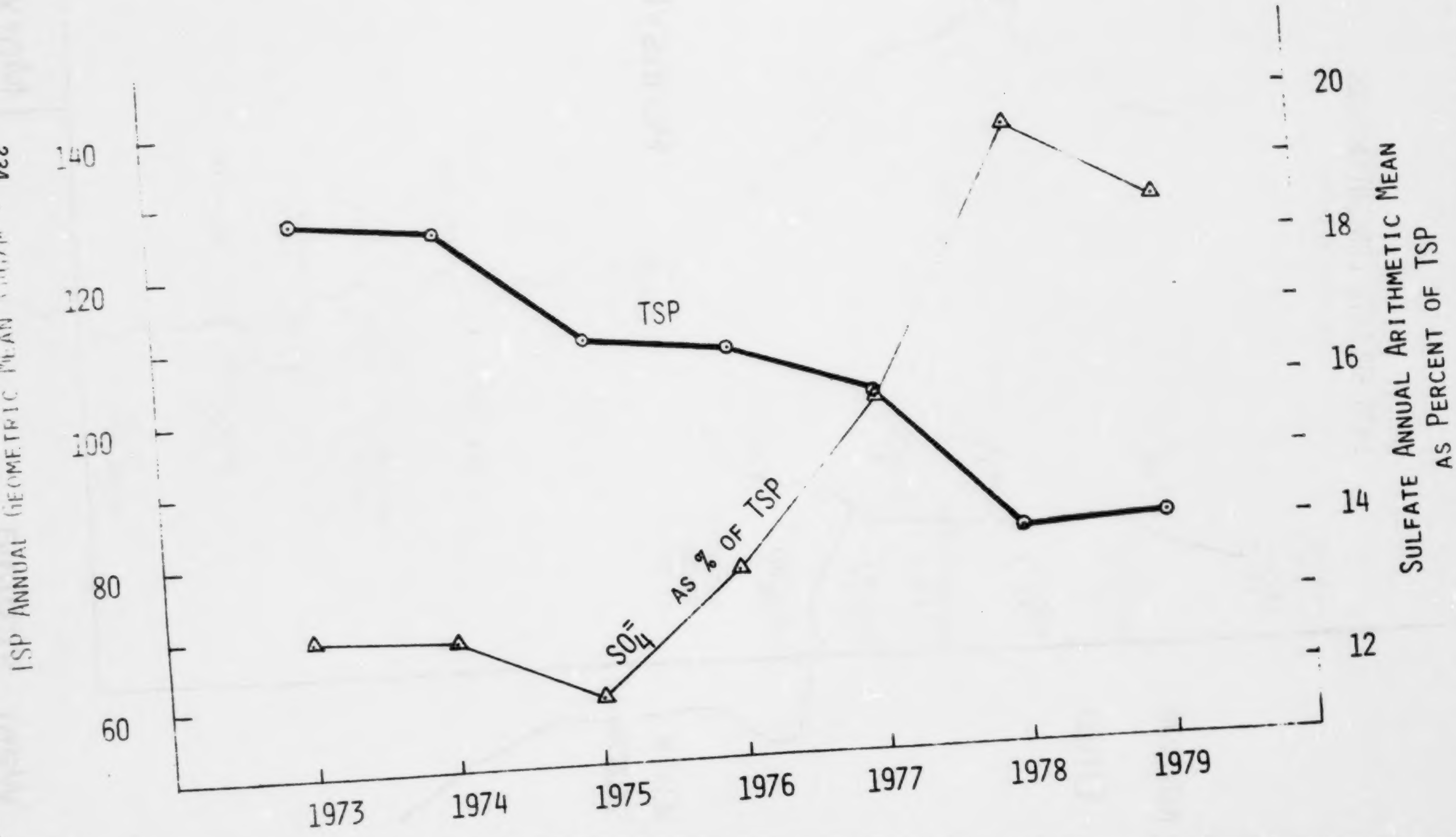
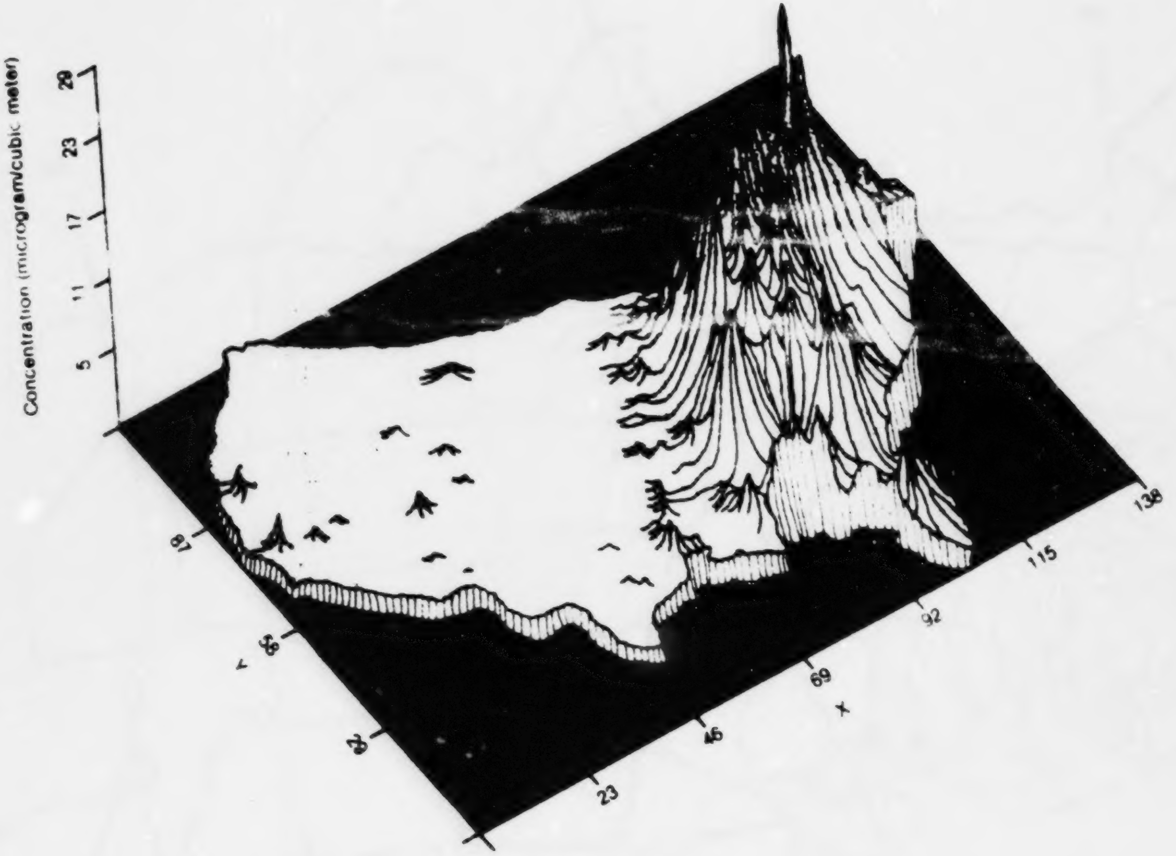
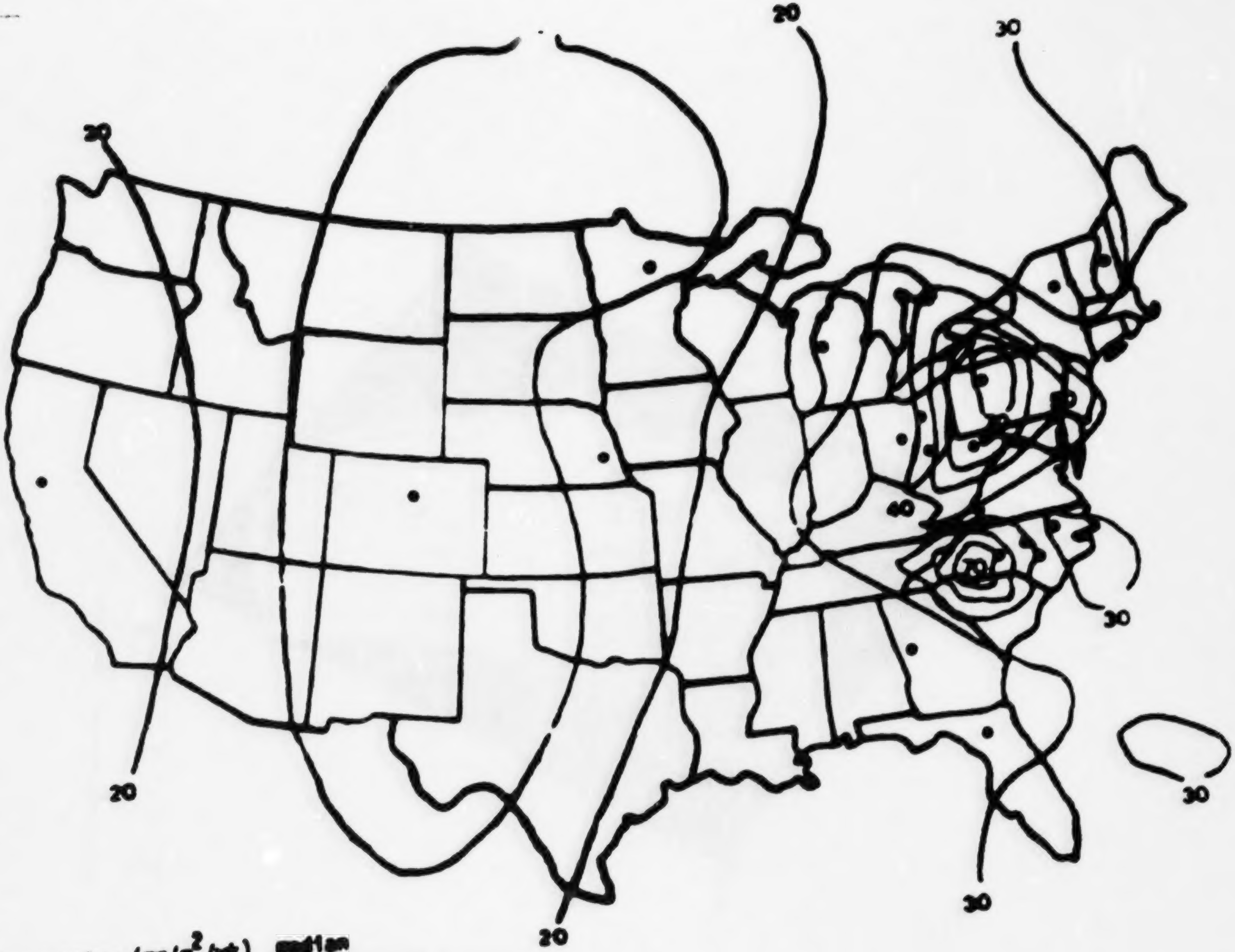
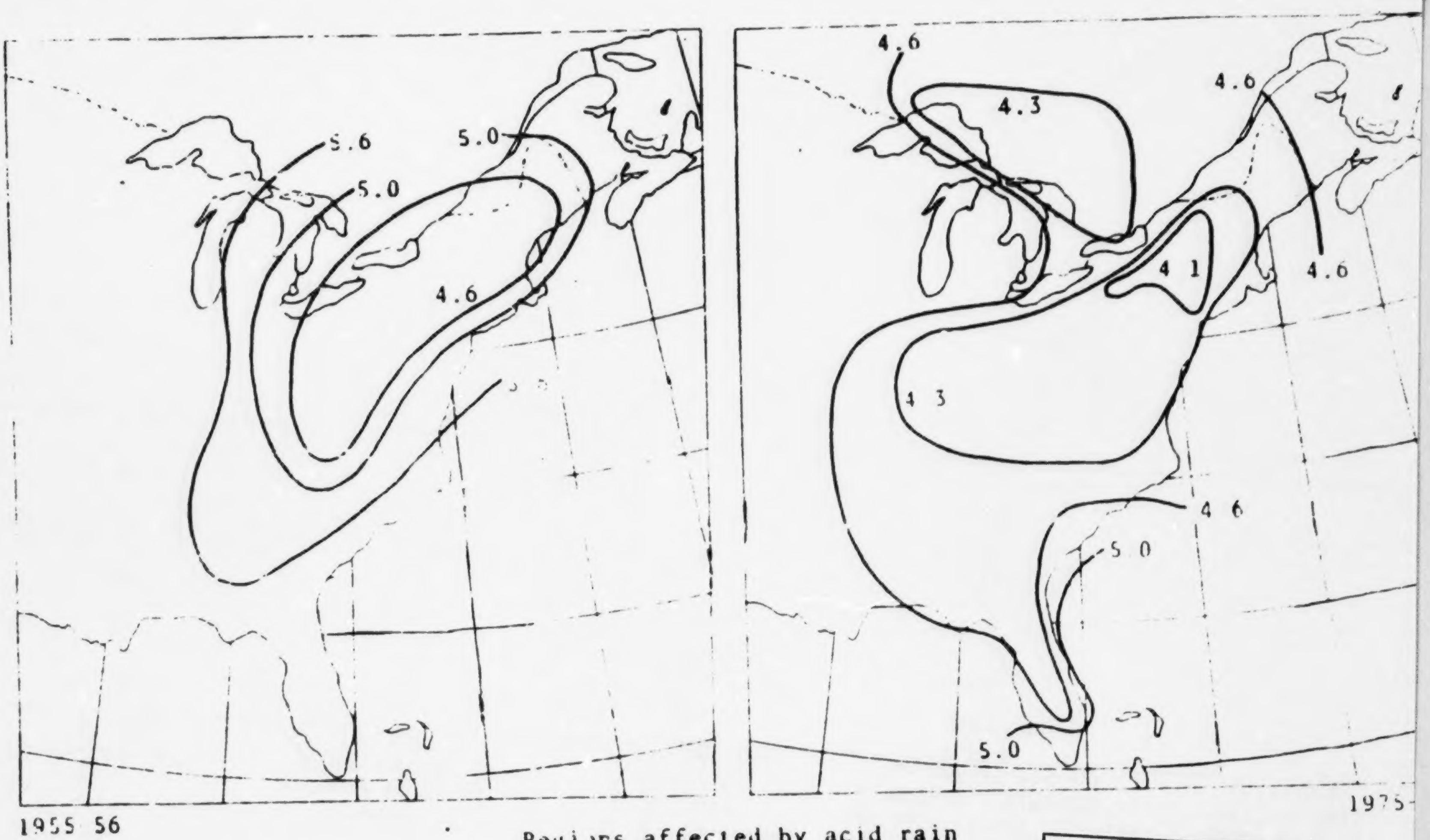


Figure 26.—Annual Concentrations of Sulfate for a 1990 25.7 Quads Coal-Use Scenario
(Brookhaven National Laboratory, 1978)




20
20
20
30
30
30
30
20
20
40
70

SO_4 Deposition (mg/m^2/wk) median
National Atmospheric Deposition
Program (NADP)


5.6
5.0
5.0
4.6
1955 56
4.6
4.3
4.6
4.1
4.6
4.3
4.6
5.0
5.0
1975

Regions affected by acid rain

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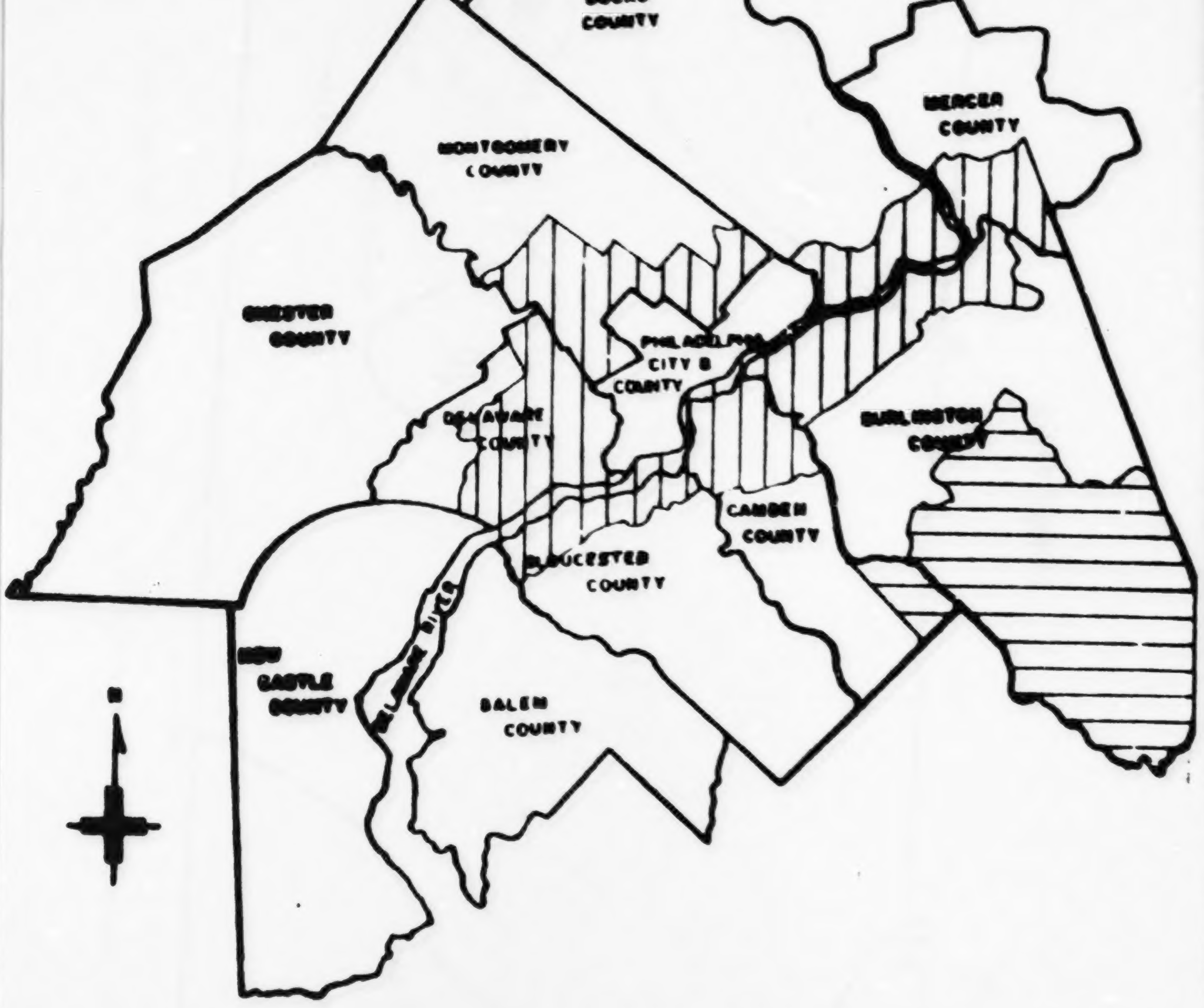
Figure 5. Isopleths showing Annual Average pH for Precipitation in Eastern North America (modified from Likens et al, 1979).

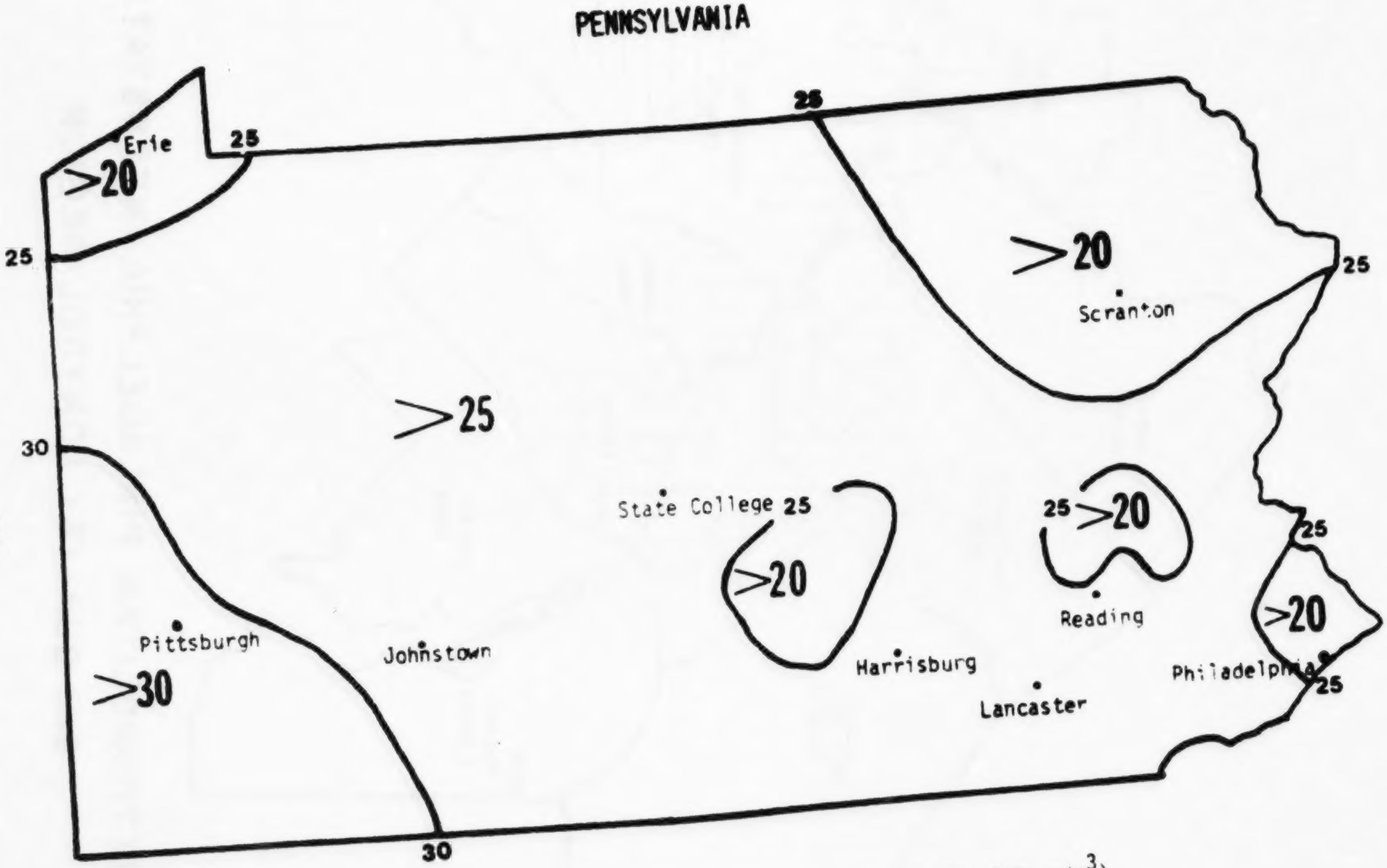
Potential SO_2 Reduction from Coal Cleaning

Utility Coal Fired Power Plants

State	Number of Plants	Number of Plants Emitting > 4#/SO_2/MM BTU in 1977	Total SO_2 Emissions from those Plants in 1977 (10^3 Tons per Year)	Reduction in 10^3 Tons SO_2 per Year if all Utilities went to 3.7 #/MM BTU as an Annual Average	Percentage Reduction of all Utility Coal Emissions
Ohio	32	24	2,695	800.68	30
Illinois	27	16	1,389	423.29	30
Indiana	26	19	1,454	404.48	28
West Virginia	12	2	992	111.20	11
Pennsylvania	27	1	1,375	30.3	2.2


BUCKS COUNTY
MERCER COUNTY
MONTGOMERY COUNTY
CHESTER COUNTY
PHILADELPHIA CITY & COUNTY
DELAWARE COUNTY
BURLINGTON COUNTY
CAMDEN COUNTY
GLOUCESTER COUNTY
NEW CASTLE COUNTY
DELAWARE RIVER
SALEM COUNTY
N

METROPOLITAN PHILADELPHIA INTERSTATE AIR QUALITY CONTROL REGION


PENNSYLVANIA
Erie
>20
25
25
25
>20
Scranton
25
>25
30
State College 25
>20
25 >20
Reading
25
>20
Philadelphia
25
Pittsburgh
>30
Johnstown
Harrisburg
Lancaster
30

1979 Sulfate mean expressed as a percent of the secondary NAAQS for TSP (60 μg/m^3).

Mr. Carl Beard: Walt, could I make one short comment at this time? Jim points out Cammer Mitchell in Harrisburg. Cammer Mitchell is almost totally washed coal. While you are thinking about this, that coal is already washed, has been for years, and better than 70% of the coal in Harrison is washed. These are mine mouthed plants. As you are thinking toward a solution to a problem, keep that in mind.

Mr. Hawkins: Bud Hovey from New York.

Mr. Hovey: I am going to speak with two hands. The first, STAPPA. As most of you know, STAPPA is the State and Territorial Air Pollution Program Administrators, and STAPPA appointed a committee on long-range transport of pollutant. This committee was made up of representatives from the States of Oregon, Oklahoma, Ohio, Pennsylvania, Connecticut, Georgia, and New York. Originally Wisconsin was a member of the committee but the Wisconsin member left the ranks of the air pollution directors for a better job in the State of Colorado and he is no longer a member of the committee, although he did participate in the last meeting the committee had.

Because of the serious problems of transported pollutants and because of the concerns over acid precipitaiton (as only one of the transported pollutants), the committee was put together and has come up with some positions which were presented in the form of a resolution to the STAPPA Executive Board. The Board approved the resolution just before the meeting and that is why the copy that was passed around to everybody at the table had the word proposed at the top scratched out. As we set forth in this STAPPA position, the current law cannot adequately address the problems of long-range transport of pollutants, particularly through the SIP process. Thus, it appears evident that the law should be changed to accommodate equitable control of sources of transported pollutants. Acid rain is only one of these long-range transported pollutants and should be treated in the same manner as the others.

If Congress would change the law in the next year or two so as to require reasonable control measures, and if such legislation requires EPA to develop regulations, then it would be to everyone's advantage if EPA started now to address the acid rain precursors. We believe this can be done under Section 111(d) of the Clean Air Act. While this is a complicated procedure, it would get the technical work started so the regulations would be forthcoming soon after a change in the law. Furthermore, if the law is not changed, EPA would have some mechanism, incomplete at it may be, for dealing with the acid rain problem.

Many of you might wonder how we could use Section 111(d). For those of you who are not completely familiar, 111(d) can only be applied for non-criteria pollutants. Section 111 of the law requires that EPA adopt new source performance standards. Once they have adopted it for a non-criteria pollutant, they then can adopt a standard for existing sources for that same noncriteria pollutant.

What is the noncriteria pollutant in this case? Is it sulfate, nitrate, or is it total sulfur, for example? One of the approaches would be to consider either sulfate or total sulfur as the noncriteria pollutant. EPA has already adopted emission standards for sulfur dioxide, which is a criteria pollutant for new power plants. By the same token, the control of sulfur dioxide, in effect, gives you the control of the total sulfur emissions. Using that logic, there is the possibility of using Section 111(d) then as a mechanism for controlling total sulfur emissions from existing power plants.

We have not tried to do any legal research on this because I think you could argue both ways. EPA should get on with this type of work. If there are challenges to it, so be it. But one thing, if there are challenges to it, it may help us move forward to the necessary changes in the Clean Air Act to address the issue of transported pollutants and an equitable method of addressing the transport of pollutants.

To help those of you who did not get a copy of the STAPPA resolution on the long-range transport of pollutants (and I hope all the States got a copy) the resolve reads as follows:

A National Policy on Acid Deposition and Regional Consistency

State Proposal Presented
April 9, 1980
Springfield, Va.

I. INTRODUCTION

The official representatives from the states listed at the end of this document agree with the substance of the discussion and recommendations which follow. These states come to this conference with the hope that the states who are participating can develop a series of positions that will lead to the solution of long range transported pollutants and EPA's inconsistent administration and inequitable enforcement of the Clean Air Act. Regarding acid rain, we are not here to blame one region of the country as the responsible party, since all of us contribute to this serious environmental problem. We are here to find solutions and to work collectively with the other states in developing a position which can be supported and utilized by us all for control of transported pollutants. Our goal is to ensure that all states are subject to consistent and equitable requirements under the provisions of the Clean Air Act. And that one state or region of the country does not suffer because of inadequate controls imposed in another state or region.

Acid deposition and the long range transport of pollutants is a phenomenon which has become widely recognized in only the last 20 years . It is safe to assume that without the introduction of large scale power plants which has increased sulfur and nitrogen oxides emissions, and the "tall stack" policy which has resulted in impacts far removed from the source, we would not be facing the severe long range transport problem. Accordingly, we are most interested in a program which will ultimately reduce the total sulfate and nitrate burden to the atmosphere and allow for the equitable and consistent administration of the Clean Air Act.

We are proposing a program which we feel can address many of these needs and provide the United States with a solution to this problem, as well as equity of consistency under the requirements of Federal laws.

II. PROPOSED PROGRAM

Our proposed program includes the following six elements:

1. Administrative and regulatory action under Section 111(d) of the Clean Air Act

2. Requirements for coal washing

3. Legislative action to amend the Clean Air Act to require national emission limits

4. Retrofit of existing power plants to meet national emission limits.

5. Nationwide emission monitoring

6. National consistency of actions among EPA Regions.

A. Immediate Administrative Action

Utilization of Section 111(d) of Clean Air Act to develop emission limits for existing sulfate and nitrate emission sources (i.e., power plant combustion installations, refineries, smelters).

1. New Source Performance Standards (NSPS) are currently required for sulfur dioxide and/or nitrogen oxides from these sources.

2. Sulfur dioxide and nitrogen oxides convert to sulfates and nitrates in ambient air - ergo implied NSPS for sulfates and nitrates!

3. Section 111(d) requires EPA to adopt emission limits for existing sources of "non-criteria" pollutants when NSPS are adopted for the same pollutant-source.

4. Sulfates and nitrates are "non-criteria" pollutants.

5. EPA should immediately start development of reasonable control measures for these pollutants and sources-particularly power plants with tall stacks. EPA should notify the states within 60 days of this conference whether it intends to utilize Section 111(d).

B. Coal Washing

In accordance with our desire to reduce the total sulfate burden as soon as possible, we feel that a national program requiring coal washing should be mandated. Coal washing represents a first step that could be taken to reduce sulfur emissions. Current thinking tells us that a coal washing program, using the best available technology, could achieve sulfur reductions of between 10 and 20 percent. By requiring coal washing on a national level, it becomes a cost-effective means to reduce emission levels.

Certainly there are clean coals available and such a requirement should not be imposed on low sulfur coal. However, much of the coal available in the East, the area adversely affected by acid precipitation, is not low in sulfur and coal washing could help achieve both a cleaner and more efficient fuel source.

We are well aware that some states are taking steps to require coal washing, however, if we are to achieve national objectives and continue our efforts to protect the environment, it is important that the requirement that utilities burn cleaned or clean coal be made on a national level.

C. Legislative Action

The states and EPA should join together in a request to Congress to amend the Clean Air Act so as to require emission limitations on existing sources capable of emitting significant amounts of sulfur dioxide and nitrogen oxides especially from tall stacks.

1. Administrative procedures as in "A" above may be challenged by legal action, thus a change in the Act would provide for relief from such a challenge.

2. Congress would be recognizing equity of control measures and inequity caused by current SIP process.

3. Other transported pollutants also could be addressed in this manner - ozone, fine particles, etc.

4. Justification for changes could be developed by a joint EPA-state technical committee.

5. Industry should be asked to participate in developing this reform approach.

D. Alternative Legislative Action

Concurrently with "C" above consideration should be given by Congress to require all existing power plants to be retrofitted to be consistent with national emission limits within a reasonable number of years so as to achieve an emissions reduction of pollutants on a nationwide basis.

E. Monitoring Program

As the nation becomes more and more dependent upon coal as a fuel, it is important that we have information on the amount of sulfur dioxide and nitrogen oxides actually emitted from power plants. Therefore each coal-fired power plant should be required to install continuous in-stack monitors to provide the operators with up-to-the-minute information on plant emissions.

Such a system allows utilities to exercise much more effective control on their day-to-day plant operations. Monitoring systems utilizing high speed computer technology are now available and can easily provide the information necessary to completely monitor emissions.

F. National Consistency

To assure consistency of actions among EPA Regions, the Administrator should establish a National Consistency Review Council (NCRC) which will act as an appeals board and report its recommendations to the Administrator.

The NCRC would be made up of one member from each EPA Regional area with the members representing EPA Regional Administrators, State Air Pollution Administrators, elected officials, industry and commerce, and the environmental public. This committee of ten would review requests where there is a feeling that inequitable and inconsistent treatment has taken place.

As an alternative (or interim measure) to this proposal, the National Air Quality Commission, which is already established and functioning could be given additional responsibilities to act as a consistency board.

III. PROGRAM IMPLEMENTATION IN RELATION TO COAL CONVERSION

If the United States is to reduce its dependence on foreign suppliers of oil, it is important that we look towards fuller utilization of one of this Country's most abundant resources -- coal. With coal conversion comes the serious threat of extensive environmental degradation. Therefore, it is important that we ensure that when coal conversions take place, they be done properly and that cert ain areas of the country are not adversely impacted over others.

Recently the Administrations oil backout program, the Power Plant Fuel Conservation Act of 1980 was introduced in Congress. Contained in this legislation, as been proposed, is the requirement that 50 plants nationwide convert to coal. This imposes an additional burden on the states which are already most severely impacted by transported pollutants. Also this imposes an additional burden on the states which are currently experiencing widespread violations of the national ambient air quality standards for TSP unless the conversion to coal can be accomplished without further increasing pollutant transport and subsequent exacerbations of these violations.

Clearly, this effort will require that strict environmental safeguards be followed. The cost of these safeguards will be staggering. We are prepared to follow these requirements once they are developed. However, before we can completely support such tremendous effort, we must be assured that efforts to protect the environment will also be required in other parts of the country now heavily dependent on coal.

We also feel that the amount of money which has been targeted in the legislation for environmental protection, $400 million, is not sufficient to significantly address the problem and that the amount should be substantially increased.

Certainly coal conversion represents both a great need as well as a serious threat to the United States. Therefore, a complete impact analysis must be done before coal conversion can be required on a large scale. This impact analysis should not only assess the environmental impacts of large scale coal conversions, but should look at all other impact associated with these changes. Without addressing such factors as availability of fuel, price of fuel, cost of conversions, type of technology required to properly burn the fuel, and current costs of electricity, it is impossible to require one region of the country to make major changes and comply with strict environmental criteria without addressing the same requirements in another region.

To ensure that appropriate environmental safeguards are implemented simultaneously with the oil back-out legislation, Congress should amend the law as recommended in accordance with items C through F above.

Under no circumstances should our recommendation be construed as a request for additional ambient air quality standards -- especially for pollutants transported long distances. This would only add to the control inequity now being experienced throughout the country.

SIGNATORS

State	Name
Maryland	George P Ferreri
NEW Hampshire	[illegible]
Maine	David E Tudor
NEW JERSEY	George J Tyler
Connecticut	Stanley J Pac
Rhode Island	Thomas E Wright

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SIGNATORS

State	Name
NEW YORK	Robert Flacke
Massachusetts	Anthony D. Cortese

Now some of the measures that the STAPPA committee considered for immediate viability would be: first, coal washing. I heard Carl Beard mention that coal washing is already used at some of the plants. That is true, but coal washing is not used at all facilities. It is not used for all major coal that is being produced. It would have some impact on the total loading of sulfur dioxide into the atmosphere. It could be considered as a reasonable emission control measure, and from what I have heard, the cost factors are such that it would not be as expensive as some other things that might be considered. At this time, the STAPPA committee did not feel it could presume to suggest a cut-off level below which coal should not be washed. I don't think we (STAPPA) have enough information to consider that level. I think that would best be considered jointly by an EPA/STAPPA committee, in cooperation with both the producers and users of coal. As stated in the resolution, economic incentives such as early tax writeoffs, would help sell this concept. Tax writeoffs for coal washing may be an entirely new approach, because coal washing benefits the coal and the IRS looks askance at trying to give a tax write-off for that. But, maybe we could get Congress to change their minds.

While EPA is developing regulations under 111(d) and Congress is considering the Act, the STAPPA Committee also recommends that the States look into the possibility of requiring coal washing on a voluntary basis, over and above any SIP requirement. The States would need some guidance as to cutoff requirements but, in general, I think we might be able to move faster than EPA and Congress. If the coal producing States were to lead the way in coal washing, I am confident the other States would very readily fall in line; I know New York would.

There is another advantage to coal washing that has nothing to do with the long-range transport of pollutants, but has to do with the possiblity of helping to control particulate emissions for the secondary pollutant problem. Some areas of the country do not meet the secondary standard for total suspended particulates. If coal washing were considered by EPA as reasonably available control technology for power plants towards meeting the secondary standard, then this would help in those areas which currently do not meet the secondary standard where we have coal-fired power plants that are using coal that is not washed.

We have been mentioning the SIP requirements here, and I have heard Dave Hawkins mention SIP requirements a number of times this morning. It is my opinion, and it is not necessarily the opinion of STAPPA (I want to emphasize that, because I did not clear this with the committee) but it is my opinion that the SIP process has not been completely successful. I think a lot of people would agree with that. Change is needed. Control of existing sources on an equitable basis, without worrying about developing SIPs and meeting ambient standards would be a better way of deploying our very limited technical resources.

Air quality was improving before we had ambient standards and SIPs. If you recall the New Jersey presentation, and if you looked at the chart, you could see, for example, that there was a tremendous reduction in sulfur dioxide before 1970 on that chart. More than half of that 85% reduction that they were talking about was achieved well before 1970 and well before 1971 or 72, when SIPs came into being. Air quality, as I said, was improving then and it will continue to improve if we utilize best technology for new sources and reasonable technology for existing sources.

We, in New York, believe that any new ambient standards would lead to more inequity and more paper shuffling. Because of that, and to provide for input from the States not represented in the STAPPA Long-Range Transport Committee, a State's position was also developed in the past two days for your consideration. This position, hopefully, has been given to every State, and if any State has not received a copy of "A National Policy on Acid Deposition and Regional Consistency - State Proposal" presented April 9, 1980, Springfield, Virginia see Peter Fairchild and get a copy. I am going to quickly again summarize what this document says.

What we are saying, at the very beginning, is that the official representatives from the States listed at the end of this document agree with the substance of the discussion and the recommendations which follow. This is not a commitment of the Governors. It is not a commitment by those who signed to every single word. What it is is an agreement in the principles that are involved. We have a number of proposed programs, basically divided into six elements: (1) the administrative and regulatory action under 111(d) of the Clean Air Act; (2) the requirments for coal washing; (3) legislative action to amend the Act to require national emission limits for existing sources; (4) a retrofit of existing plants to meet those national emission limits (that is rather redundant because if you have national emission limits for existing sources, the retrofit is implied anyhow); (5) a nationwide emissions monitoring program primarily from the coal-fired power plants; and (6) national consistency of action among EPA regions.

How do you achieve all these things? One way to achieve the regulatory changes is to consider implementing the program in collaboration with the oil backout legislation, the coal conversion requirements. We are going to be converting to coal in the Northeast. Some 50 plants are supposed to convert to coal, and 42 of these are along the East Coast of the United States. I am not sure where the others are located, but at least 42 are in the Eastern United States. If we are going to convert to coal, we need some relief from the total sulfur that is being emitted to the atmosphere. Some of these provisions would help provide for that relief. By incorporating these changes in the President's bill or simultaneously with the President's bill on oil backout legislation, we could get the necessary changes that we need to make the Clean Air Act work for us without completely opening the Clean Air Act for revision at this time. In the interest of time, and so that we can get back on schedule, we will save any discussion on this and I won't go on any further until the discussion period. Thank you.

Mr. Hawkins: Thank you Bud. Dan Goodwin will be next.

Mr. Goodwin: Good morning, my name is Dan Goodwin. I am head of the air pollution division of the Illinois Environmental Protection Agency and my task here today is to try to present to you the acid rain problem as viewed from the perspective of a coal State.

I would like to start by saying that I bring you greetings from Illinois, a net exporter of corn and soybeans, coal, manufacturing jobs, sulfur dioxide, and I am tempted to say electricity, but I have not checked the figures on that. We may not be an exporter of electricity. I would also like to start by saying that the entire State of Illinois is in attainment of the national ambient air quality standards for sulfur dioxide. With those two statements, those of you who have political inclinations can probably figure out what the rest of my speech is going to say.

I want to touch on five subjects. First, how we see the environmental problem, how we see the political problem, some problems that we see with a few of the suggested solutions, some elements of an ideal national strategy on acid rain, and what we see as the next immediate steps that are to be taken.

I think sufficient evidence exists that there are real problems due to acid rain in the Northeast to warrant action. I will start today from the point of departure that we are also going to accept that reduction in total SO_2 and NO_x emissions loading in the Eastern part of the United States is a rational first step in dealing with that problem. Nevertheless, I think it is also important for you to note that neither the acid lake problem nor the sulfate particulate formation problem has been observed in Illinois. I think that being the case, it is going to be very difficult to get the attention of the legislators and others at the State level to the problem unless we approach it properly.

Let me turn to the political problem. Any regulatory action that is perceived or portrayed by the coal industry or the electric utilities as anti-coal will be politically difficult to accomplish in Illinois. This will be true regardless of how convinced the environmental regulatory agencies are of the need for regulatory action or the harmlessness of any proposed action to coal interests. Whatever hope there may be for successfully instituting new regulations on the use of coal lies in convincing the coal industry that its economic interests will be well served by such regulation.

The coal industry in Illinois has political influence far disproportionate to its size and overall economic importance. Working in the mines is woven into the social fabric of the community of large areas of Illinois, particularly in the Southern part of the State. Southern Illinois and coal mining are concepts that are as closely identified with one another as Cape Cod and fishing, or Maine and potato farming.

The United Mine Workers and the coal operators rarely agree on things but they do consider further environmental regulations a serious threat to their economic well being. Together they represent a powerful coalition.

Most coal mines in Illinois lie far from the major industrial centers where air pollution is a highly visible problem. In terms of citizen awareness of air pollution, it is farther from Chicago to Carbondale than it is from Chicago to Lake Placid. Historically, legislators from the Southern Illinois coal fields have possessed clout in the legislature well beyond what would be expected from their numbers. With the apparent demise of the Chicago Democratic Organization, that clout is likely to grow.

The coal industry and the electric utilities both have long traditions of resisting environmental regulations, and it seems reasonable to expect them to continue in that tradition. Virtually any regulatory action that is proposed to mitigate acid rain or sulfate formation is likely to be perceived as having an adverse effect on either coal or the utilities or both, whether the impact is really negative or not. This picture will be complicated by differences in interests in owners of high sulfur coal reserves and low sulfur coal reserves, and between utilities who have large fractions of their generating capacity presently burning high sulfur coal and those who do not. In other words, we cannot necessarily assume that all members of the industry will perceive their interests to lie in the same direction.

There is another increasingly important source of resistance to the kinds of measures being discussed here today, namely, the citizen activist groups who have recently emerged in Illinois as vocal and effective spokesmen against the utility rate increases before the Illinois Commerce Commission. These groups describe themselves as representing the interests of residential electric customers, especially the senior citizens and poor people. Rate increases that would have been granted almost automatically five years ago are today being thoroughly challenged and carefully scrutinized. One can no longer assume that cost increases for the utilities will be fully passed through to their customers. In fact, there is serious discussion in Illinois of abolishing the fuel adjustment clause, which allows automatic pass through of fuel price inceases by utilities.

In Illinois there is little likelihood that a strong effective acid rain lobby will come into existence in the near future. Most Illinois envionmental groups including the Chicago Lung Association and Citizens for a Better Environment have worked hard in recent years to portray themselves as not being anti-coal. Their principal theme has been human health protection. Unless acid rain or sulfate formation emerges as a more serious and immediate threat in Illinois, it does not appear probable that groups such as these will become highly visible in pushing for new regulations on Illinois coal. National environmental groups such as the National Resources Defense Council and the Environmental Defense Fund, should they become active at the State level in Illinois would most likely be regarded as carpetbaggers and probably do their cause more harm than good.

I will add to all that, that in the Illinois State Government, I am probably the greatest friend people who want a solution to the acid rain problem have. My purpose is to try to help you understand the realities that my agency or anybody in Illinois who is going to push for more regulation on coal and on the electric utilities is going to be up against in securing that at the State level.

Now I would like to talk a little bit about some of the problems that I see with a few of the suggested solutions that have been discussed.

First, the cause/effect relationships between SO_2 and NO_x emissions and acid precipitation are not well understood. Because of this it is not clear that any particular proposed remedy will be beneficial or cost-effective. No short-term solution to this problem seems available but there must be adequate long-term research done. I think the commitment the U.S. EPA received from the President goes a long way in that direction. In the short-term, I believe we must concentrate on remedies that are low in cost, or low in risk, and that can be shown to be cost-effective in terms of total emission reductions.

Next, problems with coal washing. I think the benefit that may be available from a universal coal washing policy are more perceived than real. In Illinois, roughly 90% of the coal now being burned is washed.

It is less than 1.8 pounds SO_2 per million Btu, that is low sulfur (mostly Western) or is scrubbed. I think before we jump on the coal washing band wagon we need to do a survey to determine whether or not it is really going to gain us enough emission reductions nationally to be worth the debate that is likely to be generated by any mandatory policy. Washing may be technologically difficult in water-short areas, particularly in the West. Yet if coal washing is not to be a policy that is extended throughout the country, particularly into the low sulfur western coal mines, it is going to be difficult politically to get acceptance of the policy in Illinois which is a State that finds itself particularly vulnerable to inroads by western coal. There has to be maintained some kind of economic equity for high sulfur versus low sulfur coal in this policy.

In addition, coal washing can create water pollution problems that in some instances are not that easily solved. In most cases, you can solve the problem but we have encountered some places where there really is not any place that is very sound to put the water that you must dispose of.

It is argued that the nonair quality benefits of coal washing may justify its use. I think the first response I am going to hear from this back home is: "Well if that is true, why do we need a regulation? Maybe all we need is better education of the coal users." Frankly, I have no response for that question.

Moving to the idea of a cap on total SO_2 emissions. I think a cap on SO_2 emissions at their present levels would offer a serious problem of inequity among the States or substate areas or individual sources if the cap is applied on that scale as opposed to a multistate or national scale. Areas which are now in overcompliance with their SIP emission levels would lose their growth capacity while those who can achieve emissions reductions below their present levels by the simple expedient of coal washing would get a very cheap margin of growth by doing that. On the other hand, if we are going to try to apply a total emissions cap on a multistate or national scale there is going to be a difficult problem of how you allocate whatever growth margin you provide in that arrangement. I have serious doubts that that can be done without either Federal legislation or an interstate compact neither of which is likely to come very quickly.

One version of an emissions cap, that I have not heard discussed and I think might deserve further exploration, is a cap on emissions per kilowatt hour generated, applied to the utilities on a system-wide basis, with ample provisions for controlled trading among the utilities, so that they can buy power from each other within the limitations of their caps in order to meet their load demands.

Now, some elements of an ideal national strategy, and this is from the perspective of Illinois. The ideal strategy must advance the interests of the affected segments of the coal industry. It must not provide further opportunity for inroads by western coal into traditional Midwestern and Appalacian coal markets. It must open up new markets for high sulfur coal such as displacement of oil and natural gas in the Northeast. It must allow pass through of cost increases to the customers. It must create new jobs in the coal fields, or at least pose no threat to existing jobs.

The ideal strategy must be acceptable to the electric utilities including those who will not benefit from the oil backout program. They must be able to pass cost increases through to their customers with a high degree of certainty. Rate increases for industrial customers must assume a relatively uniform national pattern in order not to further displace existing industry from the Midwest and Northeast to the sun belt. Each utility's ability to acquire adequate increases in generating capacity must be guaranteed. The ability of each utility to finance additional control equipment must be assured. With today's interest rates and with the capital formation requirements that are already on the utilities, that is an important issue. These financial costs must be included in the rate base.

The ideal strategy must minimize the impact on industry other than the coal and the electric utilities in order to keep them uninvolved politically. To do that the electric rate increases resulting from the strategy must be small and must be equitably distributed.

Industrial boilers should not be included in the new control requirements. The ability of each economic region to accommodate industrial growth must be retained.

The ideal strategy must not pose the prospect of large utility cost increases for residential customers. Active opposition by old people and poor people will be the death knell in Illinois should that occur.

Now, to the extent that we can devise an acid rain strategy or a total emissions reductions strategy that meets all those requirements or comes close to them, I think we will have something that will "play in Peoria." To the extent that we are unable to do that, it will be difficult.

I want to thank you for setting me up for the last section of my comments, which concern what we should do over the short-term, because I think that is where we ought to be focussing our attention today. On the assumption that the long-term problem is going to require amendments to Clean Air Act which are not likely to come for at least a couple of years, I think that the first thing we need is a call to responsible action by the States from the President. I think we can be led, speaking for the States. I do not think we have to be coerced. We need Federal leadership, coordination, and technical assistance. But, we do not have to be bludgeoned into action. I think it is important that the President stop equivocating. If acid rain is the serious problem that he has said he believes it to be, I think he must make some forthright statements as to what kinds of actions the States should be taking today or in the next few months to deal with it while the Congress is considering the legislation needed for a long-term solution to the problem. I also think the President needs to make a definitive statement of how contemplated solutions to the acid rain problem relate to the oil backout policy.

Secondly, I see a need for immediate joint action by U.S. EPA and the Department of Energy to study the potential short-term emission reductions that may be available from greater use of washing for currently unwashed coal, and use of improved washing techniques for currently washed coal. This needs to be done plant-by-plant for all the utilities in the East and it ought to be done in the next six months. I think U.S. EPA and DOE need to do more evaluation quickly of the two nonstructural alternatives that were mentioned but not really fully discussed yesterday, namely, least emissions load dispatching and accelerated retirement of high emission facilities. I think both of these concepts offer the prospect of significant emission reductions at little risk and small cost over the short-term.

Third, immediate steps need to be taken to shorten the lead time to obtain permits and licenses for new relatively clean facilities. More and more, I am hearing that the emerging PSD regulations are inevitably going to place the PSD permit process on the critical path for new coal-fired power plants that are currently in the planning stages. To the extent that this is the case, they stand as an obstacle to replacing old high emissions capacity with new low emissions capacity, and I think we could do a better job on that if we work at it.

Fourth, and please forgive me for stepping on toes, I know I am going to do it with this topic, we have got to break the paralysis that grips the nuclear regulatory licensing process. I think this is an important point, whether or not you believe there should be further investments in nuclear capacitity in this country. We have a large number of nuclear units under construction now, and the NRC operating license process is rapidly becoming the obstacle to getting those units in service. One of the things that came out of the OBERS study was a collective opinion that, looking at the total fuel cycle, there is greater risk of premature death as a result of the coal fuel cycle than of the uranium fuel cycle. I think it is time for us to be realistic. I am not saying we should take any shortcuts on nuclear licensing but let's speed it up. It can be speeded up.

Finally, I would just like to speak to the proposal that Bud Hovey suggested and some of the other States have endorsed that we use 111(d) authority to initiate a Federal program on acid rain. Illinois cannot endorse this at this time. I doubt that we ever will. I think we lack the technical basis for setting such standards, I do not think that authority is well suited to the purpose, and if we select that course of action, we will inevitably get tangled in two or three or four years of litigation. That will stand as an obstacle to actions that could be taken that will produce results much sooner than that. Nevertheless, I think joint cooperative efforts by the States are the way to go while we are waiting for Federal authority, and Illinois stands ready to cooperate in developing a national strategy. Thank you.

Mr. Hawkins: Now we have Dr. Craig Weidensaul from Ohio to make a presentation between now and 11:30. Thank you.

Dr. Craig Weidensaul: Good morning. I would like to express my appreciation and that of our delegation from Ohio for having the opportunity to meet with you and gain the benefit of your experiences and for having the opportunity to address you. I approach this with rather mixed emotions--they are the same as watching your mother-in-law drive off the cliff in your new Cadillac. We had a problem deciding who was going to perform this task this morning. Someone suggested our illustrious football coach or exfootball coach at Ohio State but we felt that would jeopardize the well-being of people with cameras. So I guess I am a little less objectionable. You may feel otherwise. I am not a politician and, therefore, do not need votes. I am not a political appointee so I can say anything I like.

I am the Director of the Laboratory for Environmental Studies at the Ohio Agricultural Research and Development Center and hold academic appointments in both forestry and plant pathology. Like Ellis Cowling and Jim Galloway and some of the others, I am a researcher and have been studying, for the past 10 or 12 years, the effects of gaseous and metallic pollutants, be they in air or in soil, on plants and plant metabolism. I became actively involved in the acid rain discussions and have been active in the National Atmospheric Deposition Program since its inception a couple of years ago. I am, I think, very familiar with the literature on the effects of acid precipitation and related phenomena. I have had the good opportunity of working with Jim Galloway and others in authoring sections of the Academy of Science's document on sulfur oxides. That gave me a chance to refresh my memory relative to published accounts involving not only gaseous pollutant effects per se, but those acid gases in combination with atmospheric moisture.

Today, I wear a hat not only of an objective researcher, but also the hat of the representative of the Governor of Ohio. In speaking to the subject of controlling acid rain from a State's perspective, I would like to preface my remarks by saying I hope when we are talking about control that we are not advocating complete elimination because as Ellis Cowling and Jim Galloway stated so eloquently yesterday, there are some very beneficial effects of precipitation components. On the other hand, there are some things of concern to us when acidity or any other component is in excess quantity. Let's not indict a compound simply because it is what it is, but only when it appears in excess amounts. We have not experienced or observed adverse effects of precipitation acidity as far as we know on soils and agricultural or forest crops in the State of Ohio. also, unlike other States, we do have the attention of the Governor and of our Legislature.

Ohio's efforts to control sulfur oxide emissions begin with the identification of what we hope are the real problems, not imagined problems. We then rigorously scrutinize published accounts, support research, recommend alternative courses of action, and implement control strategies and technologies. I might say that Ohio is the first State, and as far as I know the only State in the United States, to form and support a Scientific Advisory Task Force on the subject of acid rain. This does not serve a political function. It is a task force of which I have the distinction of being Chairman, appointed by the Governor, to objectively assess the importance of the acid rain problem.

Secondly, Ohio is the first and only State to introduce a mandatory coal-washing bill. This legislation would require that all coal used for steam generation (that is called electric power generation) in Ohio would be washed. This bill is expected to pass the Ohio Senate shortly. In the case of Ohio, we feel that this is a practical and advisable procedure to follow especially considering our geographic location, the sulfur levels present in coal, and the availability of washing water.

Thirdly, Ohio is the first State to fund from its own budget a fluidized bed boiler at a State facility.

Fourth, Ohio has been involved in the National Atmospheric Deposition Program since its inception, and I would like to think we were somewhat influential in its being sponsored by the Northcentral States Agricultural Experiment Stations. There are presently three deposition monitoring sites in the State of Ohio, one operated by the United States Department of Agriculture, Forest Service, and the other two by the Agricultural Experiment Station in Ohio. I anticipate that within the next year there will be probably at least three more, possibly more. At this point, I would like to echo Dr. Cowling's request for the participation of additional States in this monitoring effort. I am still one of those people who believes that, at least from a research standpoint, conclusions can only be legitimately drawn from conclusive data, and presently our network, although functioning and running smoothly, is deficient in monitoring sites at strategic locations. We need sites and we need monitoring equipment in different sections of the United States where they presently do not exist.

I would like to compliment yesterday's speakers particularly those who addressed the subjects of meteorology, transport, and effects because what you were subjected to in a few one-hour doses--each one of those presentations really could take at least a day to cover adequately. I think the speakers did an excellent job. We must be very careful to separate known facts or areas about which we have conclusive knowledge from those we know are either fictitious or must yet be determined.

In addition to certain recognized and accepted adverse effects, rain acidity has been given much credit (or blame) recently for phenomena that cannot possibly be associated with rain or that have not yet even been investigated. I disagree that this "problem" is of very recent origin. Sometimes problems surface simultaneously with our particular interests and our ability to detect them, and as you saw yesterday the problem has existed in Scandinavia for quite a number of years. I sincerely doubt if the situation is much different here in the United States.

We cannot safely or legitimately extrapolate real-world effects from rainbucket research. Mr. Robinson indicated yesterday the difficulty in associating real-world phenomena relative to terrestrial ecosystems with the suspected causes, i.e., precipitation quality. There have been laboratory studies conducted around the world, many of which have involved simulated rain (in the common vernacular that is called dilute acid; it is acidified distilled water). This is not rain. The reactions that normally occur in rainwater do not occur because many of the cations and anions are not present. Researchers in the artificial version now realize this and more and more, normal components of rain are added to the solution or natural rain is acidified to get a little better perspective of what might occur in nature. Also, many of the studies with simulated rain involve continued or repeated exposure to given concentrations of acid and this is not the way the situation exists in the real world. During a rain event, particularly after a dry period, the initial part of that event can often be quite acidic, but becomes less acidic as the acid gases are scrubbed from the atmosphere.

I think we have to be very careful in drawing conclusions from field and laboratory research at this point. There is a lot of information we really do not have. My next statement is not made to frustrate you, but having reviewed the literature for months and months, there are presently few to absolutely no published accounts, in the literature available to the public, that can withstand rigorous scientific scrutiny which demonstrate significant deleterious effects on terrestrial vegetation, either in terms of visible injury or reduced yield of food and fiber crops as a result of naturally occurring precipitation. A combination of distinctive voids in scientific information along with public concern generated--in part, by poorly documented and often misconstrued information--point out a need to objectively, carefully, and methodically research the nature, distribution, and effects of materials in precipitation. I commend the President and the Environmental Protection Agency for placing research emphasis in this area and for placing it high on their list of priorities.

The United States faces a severe energy problem, both from concerns of availability and cost as well as possible environmental insults. Until the breeder reactor is perfected, and I should add, accepted, our increasing energy demands, particularly those for electricity, can only be met by using coal. Eighty-two percent of this country's energy reserves is in the form of coal which supplies only 18 percent of our energy needs. Ohio is an exporter of electricity. As a matter of fact, 14 percent of all the electricity generated in Ohio in a given year is exported to other States.

We have a problem in Ohio. We have the dubious distinction of having coal with some of the highest sulfur levels of any in the country. Be that as it may, electricity is generated where fossil fuel reserves are located, generally due to the cost of transportation of fuel. Power generation is also dependent on the location of cooling water and, as we are soon going to experience, coal-washing water. Power plant siting is also dependent on the feasibility and costs of electricity distribution to consumers.

I think I have adequately indicated to you at the outset that we recognize the sulfur problem and are willing to pitch in and help solve it. We are taking steps now to do that. We need environmentally acceptable ways to utilize coal. Coal does cause problems and there is no doubt about that, but it also offers opportunities.

One would be quite naive to suggest or advocate ambient air quality and emission standards that would, even if they were effective, eliminate all risks to all populations, and by populations I include humans as well as terrestrial and aquatic plants and animals. The cost/benefit ratio would be staggering in terms of control equipment, capital investments and operations costs of we advocated near-zero levels. One alternative is simply to reduce our gluttonous use and misuse of energy. Similarly, we cannot permit irreversible adverse effects to our many environments and ecosystems. There is a happy medium and our wildest expectations and desires must be tempered, I am afraid, with moderation. Identifying and solving any environmental problem associated with precipitation quality will take time just as perfection of open heart surgery techniques took time. We must not be like the Indian chief in the movies who mounted his horse and "rode off simultaneously in all directions." We will not be any closer to solving our problem nor taking advantage of our opportunities if we leap at real and/or imaginary problems with shrieks of frenzy and tear-jerking testimonials. This does not get us anywhere. Let's identify our problems, sort out the real ones, design a sensible course of action, and deal with the situation step-by-step and by all means, let's get on with it. Talk is cheap, but good conscientious work speaks for itself. I thank you.

Mr. Hawkins: Thank you, Dr. Weidensaul. Those of the participants who want to make remarks, I think in the interest of being able to have the maximum number of people talk we would like to try to adhere to a rule of shortness of statement. At the outside I will be telling people when they have been going on for more than five minutes, and I hope that will be the outside. There is not going to be any order of presentation and I will try to be fair in recognizing individuals. The gentleman from Indiana, first, Mr. Strazino.

Mr. Strazino: I just wanted to second what Illinois and Ohio said. I think that goes for Indiana too.

Bob Flacke from New York: We have been very pleased both yesterday and today to see that there is some consensus. . . We have been very pleased to listen to the scientific and academic community rationally point out that the evidence and data that is available in today's scientific and academic community makes us all realize that acid deposition is a genuine problem. I think that there is basic concurrence that there is a necessity to continue to study the problem. However, the role that was outlined this morning by Ohio and Illinois does give some credence to the fact that we in the Northeast and in the Midwest sit at opposite poles. It is very difficult for people in the Northeast to understand the Land of Oz-like attitude, if I may describe it as such, that the political realities in the Midwest will only result in agreement on national policies connected with acid deposition, if they satisfy a criteria that lists things that are only good for that particular State or that particular region. We are facing a crisis situation in the country economically and environmentally in that we have a great desire to assume the use of coal in this country in an environmentally sound manner. It is no secret at all that the Federal government has pinpointed a great majority of the power plants in the Northeast for coal conversion. In order for us to successfully go through a process that will use the Northeast's money, the Northeast's time, the Northeast's effort in the process of conversion, it must be done in an environmentally sound manner. The Northeast can only accept the fact that there is acid deposition that adversely affects it, and that the rules of the game that we have been using for the past few years are no longer acceptable for the future. The way we have been administering and managing those rules are no longer acceptable for the future. So we as a group of States in the Northeast urge those in the Midwest to join with us in a serious discussion about how we are going to resolve this very difficult problem. We offer, as our suggestion for your consideration, that basic six-point program that Bud Hovey mentioned. Let's not take two or three years to determine whether or not the Environmental Protection Agency can or should have the authority to do something under 111(d). Let's do it. Let's find out if our brothers in the Midwest will contest that in court. We believe that some immediate administrative action should be taken. Let's have a national coal-washing policy. Let's begin immediately to take a look at the Clean Air Act and go back to something that has been proven long before the establishment of the Clean Air Act. That some type of point source control that will limit sulfur and nitrate emissions into the air are not only necessary but are a proven method of solving the acid deposition problem. Along with that let's establish and use part of that money for a national monitoring system. Last, but not least, let's ask the Environmental Protection Agency to establish some consistency among the Regions so that we do not have to consider when we discuss with our brother or sister States the fact that EPA Region V does it this way, or EPA Region 1 does it that way, or EPA Region II does it this way. Then we find out that it takes, for example, several months for a review process in Region II for a special limitation, but during that time several special limitations surface and are approved in another Region. I think we need an action program. I think that the action program presented by the coalition that Bud Hovey presented this morning is good, workable, and should be accepted by the Environmental Protection Agency as their program. I hope that they will respond to it in a short period of time.

Mr. Hawkins: Thank you, Bob. I will not make a practice of interjecting my own remarks after each speaker, but I would want to offer one point for Bob. One of the things that I heard Dan Goodwin saying was, if you who are sitting around the table, want a program which will get political acceptability in Illinois, here are some of the obstacles that must be overcome. He talked about an ideal strategy and I think he used the word ideal, recognizing that whatever strategy we come up with is going to represent a departure from the ideal in a number of respects. I think what Dan and others from the coal-producing States would be interested in hearing is discussions of the extent to which some of those political obstacles can be overcome.

Tony Cortese, Environmental Commissioner, Massachusetts: I would like to suggest several things. First of all, I agree with Dr. Weidensaul that we would like to have conclusive evidence before we take action. But my biggest concern is if we wait for conclusive evidence, the effects may be irreversible. We want to burn coal in Massachusetts; we want to burn coal in New England; we are burning coal in Massachusetts, but we are doing it with what we call high sulfur coal, which is one and a half percent sulfur. I say that half jokingly because up in Region I we talk about that as high sulfur coal and it compares to the four to six percent sulfur coal that is used in other areas of the country. I would hope that, as States, we can try to get together on this problem and do something about it right now. The obstacles that Dan Goodwin has laid out are there and they are real. Let's do something about them. I would like to make the following suggestions about those kinds of things. First of all, it does not bother me to see that if we are going to push for a national coal policy that there should be some way of incorporating into the rate setting for electric utility rates the cost of pollution controls. If we were to do that, I think that is one of the major obstacles to the use of locally available coal because you want, in the Midwest, to use your own coal and I do not blame you for that. You want to keep the jobs in your own State. The major obstacles there are two things: 1) you need a law that prevents the utility industries from burning low sulfur western coal, and whether that has to be a national law or whether it can be a State law I am not exactly sure, but we have the opportunity to put that in the oil backout legislation; 2) you need a law which may be either Federal or State which changes the rate structure for utilities such that pollution control equipment can be added right into the rate structure. The reason that I suggest these two options is this. We have some calculations, and I can show you the data, which indicate that our cost of electricity in New England will still be higher, even if you apply the best available control technology to the use of high sulfur coal in the Midwest, ours will still be higher. Our cost of oil, 1 percent oil, 1/2 percent oil, is in the area of $30 to 34 per barrel. The cost of 1 1/2 percent coal in New England is the equivalent of $14.50 per barrel. The coal that you are burning in the Midwestern States is at a cost of $7 to 8 per barrel. That is four to five times lower than what we are paying in the Northeast. My point is this, even if you apply the best available control technology to the coal that is being burned right now, your electrical costs will still be lower than they are in the Northeast. We are bearing those costs now and we are receiving the environmental damage from the increased emissions, the sins of omissions and emissions as was pointed out yesterday. I think the major obstacles, really, are how can we get around the issue of low sulfur Western coal and how can we get around the issue of burning oil and high sulfur coal. I submit that the two major impediments can be solved with either changes to the oil backout legislation or State laws which would change the rate setting and would also apply the use of locally available coal.

Will Brown, New Hampshire, Acting Chairman, Water Pollution Agency: I would like to endorse, without repeating, the comments made by our colleagues from New York and Massachusetts. What I really want to do is add some additional thoughts. One is that Commissioner English from New Jersey did us a great favor. She got us out of the unenviable status of being a wearer of a white hat this morning by showing on her map that New Hampshire was the wrong color in the midst of that whole New England area, thanks to using per capita figures and thanks to the fact that we do have a coal burning plant in New Hampshire. I do not believe they are washing the coal at the present time. We only have an electrostatic precipitator which works occasionally. What I wanted to comment on specifically was the contention made by our good friends from around the Great Lakes that we lack adequate data on damage. If the change in the pH of the lakes over a 40-year period of record is important, we have some such data. We are aware that the Fish and Game Department did extensive measurements back in the late 30's in many of our lakes at various stratified levels. In anticipation of this meeting, our staff was able to take a dozen of those lakes where such data is available and get current data and compare them. Practically all the data in the late 30's showed lake readings above 6 pH, in every case at the surface level. There were two lakes where it dropped into the 5 to 6 range below the surface. In every single case at every level, the pH has dropped substantially over that period. I suspect that, though we do not have the interim data to show it, that is a relatively recent decline. I would say, that on the average, it is a decline of anywhere from a half a pH point to a full pH point or more. I think that is significant. Now, my question would be. Is there a Branch within EPA where this type of data from individual States can be received and correlated and put on a broadscale basis?

Mr. Hawkins: I think that Steve Gage's presentations yesterday, and the presentations by people on yesterday's program, indicate that we, in fact, have a variety of research programs that are collecting that kind of information on the . . . Lowell Smith or someone else might be able to speak to the way in which that data comes to our attention. But we do have a variety of active projects where we are continually evaluating information that does come into the Agency, principally by having these research projects continue to update information. For example, we have recently finished some new maps of the United States that will identify all of the sensitive areas much more comprehensively than before. We are doing a variety of projects to try to improve the comprehensiveness of the data base.

Mr. Will Brown: I was thinking particularly of where we have data as far back for these ponds as 1936, 1937, 1938. That is getting far enough back so that if you can use it, we could dig it out with the comparative data for the last few years that a large number of additions are on.

Mr. Hawkins: The ORD representatives are nodding vigorously, so I will put you in touch with Lowell Smith. I thought I saw Dennis Tirpak's hand up there, but it has now gone down. Do you want to say anything, Dennis?

Mr. Dennis Tirpak: Comments could not be heard. Mr. Hawkins: I will repeat that. The Research Office of EPA will be contacting the States to find out what information you have, and also to tell you what our interests are in terms of data, so that you will have an idea of what in particular we would like to see.

Dr. Craig Weidensaul: I would like to respond to Mr. Brown's statement. Relative to the fact that it is a matter of record, no mention was made of a lack of data regarding aquatic ecosystems. The only mention made relative to a lack of data, relative to decreased fiber in food crop productivity in terrestrial ecosystems. We all acknowledge that there are harmful effects in poorly buffered lakes with unusual amounts of acidity. No question about that. We recognize the preponderance of data over the years, sure.

Mr. Will Brown: Well I commented on the relation between the aquatic and terrestrial factors yesterday, so I don't think I should repeat myself.

Mr. Hawkins: The gentleman from Wisconsin.

Bob Martini, Wisconsin Department of Natural Resources: I would just like to make a comment relative to Dan Goodwin's discussion of political acceptance of the idea of preventing or alleviating the acid rain problem with some information from our State. You may not be getting very much in the way of reaction from your public on the acid rain problem. One of the reasons could be that many of the people from Illinois end up in our neck of the woods. A lot of these letters are coming into our Agency and there is quite a lot of support, in fact, more support from Illinois residents on acid rain than there is from Wisconsin. I would just like to point out that you shouldn't underestimate the ground swell of support for protection of our vast resources.

Mr. Hawkins: I suggest that you trade letters. Get your Xerox machine working.

Dr. Weidensaul: No, I will subside as long as there is interest.

Mr. Carl Beard, West Virginia: I made a comment . . . that I suppose West Virginia . . . But the matter of coal cleaning is not answered. One thing that has not been addressed as far as I am concerned is, if coal cleaning was universally done, how much is that going to improve quantitatively, the so-called acid deposition problem? How do you

you speak to the economic question, problem one. Problem two, the people in my State who are not cleaning coal are the little producers. Where are they going to get the capital . . . to do this and not go out of business . . . ?

Mr. Hawkins: Carl.

Carl: Jim Kilgroe has prepared a paper which we handed out to you with some of our upperbound estimates on what we think coal cleaning could get. There are two errata sheets that we distributed during the break which everybody got, in case you are wondering what the two tables we handed out are. That is our estimate of what the potential is if you cleaned it all and you used the best cleaning techniques currently practiced on all the coal, and it is several million tons. You have to then discount the parts of it that are not going to be cleanable because of small producers or other problems. But, that still seems to be something greater than a million tons, or perhaps two, that is available from a broader scale uniform high-quality coal washing effort. These estimates, like all estimates, are imperfect. But, I think in terms of scale, if we have on the order of 18 or 20 million tons of emissions from steam electric power plants now (and I forget the fraction that is coal, but maybe it's 14 or 15 million) you can start to talk about 10 percent maybe as being in the range of reasonableness. I would submit that any time you talk about a million tons, a nontrivial quantity of emissions. If in fact you can get it, if in fact after you get the logical exclusions for the lower sulfur coals, the very lowest, if that's a logical exclusion, and it may not be, given what Dan was saying about competition and/or the small producers, which may be a logical exclusion. It looks to us like it is in that range. So taking those estimates as just estimates, that is our . . .

Carl Beard: All right, let me respond to that in this way. Three plants that Jim Hambright discussed, Cammer, Mitchell, and Harrison; all of Cammer, all of Mitchell at their . . . plants, coal has been washed for years from the beginning. Now, about 70+ percent of the coal for the Harrison plant is washed and more of that will be coming on stream for other purposes, not for SO_2 removal because that is Pittsburgh Paint coal. We have the same problem universally distributed throughout West Virginia . . . a sulfate problem . . . He does not have a corner on this market. But if you say universal washing of coal, what Virginia stands well . . . because if anybody wants to buy some low sulfur washed coal, it is available because the miners are out of work. Washed coal today sitting on the ground cannot be sold. I don't think it is an answer to the problem if you look at my State. We would be happy to take that as one step toward solution because we are already there.

Mr. Hawkins: Dan.

Dan Goodwin: I think Carl Beard is reinforcing one of the points I was trying to make, which is that the emissions reductions that are to be gained in several of the States as a result of coal washing may be more than real. In the first place most of the numbers that I have seen thrown around are based on allowable emissions in the SIP not actual emissions that are occurring today. In the case of most Illinois utilities, the actual emissions are substantially less than the allowable if they are located in a rural area. Now there is another phenomena that is occurring in Illinois and I am confident in other States as well and that is this. The coal that is being mined for minemouthed power plants is getting higher in sulfur as the mine working pace progresses into new areas. One example of that in Illinois is the Commonwealth Edison Kincaid Plant just a short distance south of Springfield located adjacent to what is usually referred to as the largest underground coal mine in the world. I don't know whether it really is or not, that is what Peabody says. That coal is washed under an order from the Illinois Pollution Control Board and yet they still have to have an increase in their SIP limit at that power plant which they just got recently because even with washing they cannot meet the old number. The reason is that as the coal face moves it is getting higher in sulfur. There doesn't seem to be any solution to that problem other than a change in coal supplies which is a pretty radical measure for one of the largest power plants in the Midwest. I don't think anybody has done enough homework on this subject. I don't think we really know whether coal washing is going to produce much real benefit or not, and before we go off half-cocked, that is something that we ought to look into further. It can be done within a matter of a few months. The data is available. It is not a big research effort. It is a matter of somebody sitting down in each State and figuring out what the real situation is and contacting the utilities, and contacting the mine operators, and finding out what their expectations for the next few years are going to be.

Walt Barber: Dan, is that a reasonable request that we could make of the States?

Jim Hambright: Now you want to put another burden (let me respond for Dan, if I may) on the States. And I think that they have a lot of burdens already, Walt. We would be willing to do what we can in that area, but do you have any idea how many of those things are out there to look at? We tried to do a survey as part of our research in dealing with this, of all the coal prep plants in the State, to get the information on how they cleaned it and what type of reductions they were getting. That, on a voluntary basis, got us about a 30 to 40 percent response, which is not indicative of what the total coal prep availability may be, nor is it indicative of the various types of coal cleaning that there is.

Walt Barber: I am going to let Jim Kilgroe take two minutes and describe what he thinks we know about this. I have a problem when we say we need more information about coal cleaning. We need to know what the actual practices are at steam generators and/or coal mines and then I get a reaction to a question that says we cannot find it out. If you cannot do it from Pennsylvania, I sure cannot do it from North Carolina. I don't know how to get it done. I don't know how to get from where we are to where we will have that good set of facts because everyone of you guys has had one of our contractors troop through your offices, which is the principal source of air information, and you don't like that approach.

Jim Hambright: Well, if that was a mailout attempt, if we rigorously went into it and went door-to-door, I am sure we would get a better idea. Let me say one thing further if I may in regard to coal preparation. There is coal cleaning and then there is coal cleaning. Some will do one thing and some will do something else. If we are contemplating a strategy that would contain the best features of coal cleaning, perhaps we could get a little more, Carl, than some of them are doing and maybe we will get less in some other places. It is something that needs to be looked at. But a strategy, if there is to be such a strategy, should be devised around good coal preparation, which would give us the best features of the available technology.

Dave Hawkins: Bud Hovey wants to interject.

Bud Hovey: I would like to ask Dan Goodwin a question. Dan, what is the useful remaining life of that particular plant you were talking about?

Dan Goodwin: Probably at least 20 years.

Bud Hovey: Okay. If it has a 20-year useful life, and I assume that the plant is only using coal washing, are they using any other kind of emission control for sulfur?

Dan Goodwin: No.

Bud Hovey: What about the consideration of some kind of retrofit emission control?

Dan Goodwin: For that particular facility it might be altogether feasible and technologically possible and all that, but you are not going to get it very quickly unless it is part of some larger national strategy, which is what I think we should be trying to develop. If the idea is for the Illinois Pollution Control Board to unilaterally adopt some new regulations to require retrofitting of scrubbers on facilities such as the ones that are currently in compliance with ambient standards it will be a long time coming unless it can be seen to be a part of a larger program. I would like to respond to Walt's question about State cooperation. You can get our cooperation on this and I think we have some information that will be helpful from our permit records and other places. But I think it needs to be done as a national study in order to get data that is consistent State-to-State and also to get it organized and presented in a fashion that is useful to everybody. If you want to send one of your ubiquitous consultants out to work with us for a while, we would be glad to cooperate with you.

Walt Barber: All right, a bit from Jim Kilgroe now on what we think we do know about coal cleaning and we will consider whether EPA can provide a coordinating role in terms of some sort of uniform information request on additional coal cleaning practices that we could distribute among all the States. Jim.

Jim Kilgroe: I am Manager of EPA's coal cleaning program. We have been looking at the desulfurization of coal since about 1965. With the Department of Energy and the Bureau of Mines, we have developed a number of data bases on coal sulfur levels and on the manner and the degree to which you can clean coals. I prepared a paper for today's conference and one of the reasons I prepared the paper is that there is a lot of misunderstanding about coal and how much sulfur can be removed. I think, we don't advocate coal cleaning as a universal policy for sulfur emission control. There are a lot of coals which can get 10 percent sulfur removal. We don't think that represents an adequate cost benefit for cleaning. With a lot of the high sulfur coals, however, you can get 30 to 40 percent of the sulfur out by cleaning. And this of course varies from State-to-State and it also varies within each individual State. So that, you really cannot make a decision on a coal until you look at that individual coal and look at the individual characteristics of the coal. Carl Beard brings out the fact that a lot of the West

Virginia coals are cleaned and also Dan Goodwin says a lot of the Illinois coals are cleaned. That is true. We have some information, it shows on our handout here, that roughly over 70 percent of the coals in Illinois are currently cleaned. However, we feel that a large portion of those coals may be cleaned at levels which could be improved. Also, we feel that by cleaning the other 25 percent of the coal and by improving the coal cleaning process you could get additional amounts of coal sulfur out. We are embarked on what I would call a national study to evaluate the cleanability of U.S. coal and what additional improvements can be achieved by coal cleaning. The timeframe for doing this study is probably over the neighborhood of the next six months. We already have some preliminary results which have to be confirmed by going back to the individual States, by going to the people like the National Coal Association and by asking people who are experts on coal if our conclusions are right, but I think we are developing the type of information that you need to make policy decisions.

Dave Tudor, State of Maine: There probably is no one panacea for this problem. What I would like to hear Mr. Goodwin address further is a point that he made on 111(d), we lack technology to set the standards up.

Dan Goodwin: My point is simply that I have serious doubts that the U.S. EPA has adequate technical data on which to base those kinds of standards, such that the standard will stand up to the inevitable legal challenges that are going to come from the utilites and the coal companies and I do not know who else. I do not know any reason why the States would have any desire to challenge those standards if they seem appropriate, despite what somebody back on the other side of the table suggested while ago. The States are not the ones that are going to count on that anyhow. It could be that the coal interests and the utilities--and if you look at the agony that U.S. EPA went through in their NSPS exercise for utility boilers--know they are going to be up against the same kind of agony trying to set 111(d) standards. I suspect they have got a whole lot less data to work with to back it up. What we might very well end up with if that course of action is taken is that we spend three or four or five years pursuing that course only to have the thing thrown out in the appelate court or somewhere and we are back to square 1 whereas if we took less dramatic action, if we do a whole bunch of little things that we can do here and now under present authority or with relatively minor changes in existing State programs, while we are also developing the data base and the political groundwork for providing a more explicit and well focused authority in the Clean Air Act as a part of the next round of Amendments, I think we may end up where we all want to go on this problem with a great deal more certainty and probably sooner.

Tony Cortese: I guess I would like to ask this question of my brethren of the coal-producing States. If there were national legislation that said that the cost of pollution controls--whatever is determined as the most appropriate, and I am not suggesting that certain scrubbers are the most appropriate--but, that the cost of pollution controls could be directly passed on to the consumers and there was national legislation that said that locally available coal had to be used, which meant that coal could continue to be used, would there still be objections on the part of your States do you think, to the use of pollution control technology to reduce sulfur dioxide, assuming the premises that: it is a national policy to burn coal; that we all agree that we should burn more coal, less oil, with nuclear being in limbo at the moment, and with the understanding that we have a problem that we have to make a significant reduction in sulfur dioxide emissions?

Chuch Taylor, Ohio: You have described a situation in Ohio that I think has unfolded over the last year or so. I do not know how many of you are familiar with Section 125 of the Clean Air Act. Ohio's utilities have to come to the conclusion that if confronted with stringent sulfur dioxide emission limitations the most cost-effective way for them to proceed to attain those standards is through the purchase of low sulfur, in our case, out-of-State coal. When comparing the options of continuing to use the locally available high sulfur coal with the option of including scrubbing as opposed to going out of State to low sulfur coal, they have reached the decision that for cost-effective reduction the most appropriate way for them to go is with low sulfur coal.

Mr. Hawkins: Let me just interrupt there for a moment. I think I heard Tony suggesting legislation which would remove that option by saying that controls would be put on and then the utilitiles would be . . .

Chuck Taylor: Well I know, what I was getting to is they are going to oppose that kind of legislation, violently because . . .

Tony Cortese: Are we going let the utility industries determine what is going to be the equitable . . . and environmental future of this country?

Chuck Taylor: I am not suggesting that that is an appropriate role for them to play, I am just suggesting that if that type of legislation were introduced, you can expect opposition from them and a lot of their consumers are going to agree with that opposition given the cost involved.

Tony Cortese: But that is because they have that fuel adjustment clause, which allows them to bring in low sulfur coal and . . .

Chuck Taylor: That is part of it and they can eventually acquire the cost of the associated control equipment, the scrubbing technology. There are a lot of practical constraints associated with the installation of scrubbers as retrofits on many of the urban utilities also.

Tony Cortese: I am not suggesting that scrubbers is the only solution. What I am suggesting is that whatever the most cost-effective solution is for reducing sulfur dioxide emissions in a substantial way, the coal cleaning--let's face it--I mean if we talk about coal cleaning maybe we will get 15% maybe 20 or 25%, but you are not going to get 75 or 80% reduction in emissions and what I am suggesting is you know we would be willing to support legislation which would allow the passing through of that cost directly to the consumer because it is a national policy to burn coal, but it is a national policy to burn coal in an environmentally acceptable manner. I am sure we all agree with that, those are two things I am sure we agree with.

Dan Goodwin, Illinois: Tony, if one accepts your premise, it probably eases the situation, but I do not think your premises are necessarily very realistic. First of all, even though your are saying legislation to allow the passing through of the cost, I assume what you mean is to require the passing through of cost. As far as I know all the utilities rate-making bodies allow pollution control costs to be passed through, but there is no guarantee that they will be fully passed through without a full rate-making proceeding and a lot of local opposition. If there were Federal legislation that required them to be passed through and required the capital expenditures for pollution control equipment to be added to the rate base such that the utilities could earn the same rate of return on those investments as they earn on the generator, that would probably largely diffuse the utilities opposition. It is not necessarily going to solve the coal problem, because to the extent that they are still going to be able to use low sulfur coal instead of scrubbers in order to keep the rates lower and attract additional industrial customers in their service area, that is going to be a difficult problem for the coal industry. So, if you make your legislation say that you have to have a scrubber to meet certain criteria whether . . . that may deal with the coal and utility folks, but now you are going to have the senior citizens and the poor people that were referred to on your backs. I do not think I can see that kind of legislation coming down from the Federal level in anything close to the next two or three years. It is going to be too politically volatile to get out of Congress, certainly not this year, you are not going to get it in an election year.

George Ferreri of Maryland: I would like to offer a couple of suggestions. You mentioned what can be done, immediate steps that could be taken to stop the continuing exacerbation of this problem. Should EPA possibly consider the moratorium effective immediately on any further SIP relaxations involving sulfur dioxide? There have been some figures gathered by both Massachusetts and New Jersey. I cannot attest to the accuracy of them. I think they got them from NEDS and if they got them from NEDS I am not going to question the accuracy of those figures. But I think I would like to see put together a chart showing what the SO_2 emissions . . . is being generated by the Eastern States, so we could try to normalize it and we could get a comparison of where everybody is in terms of each other.

Mr. Hawkins: One such chart was in Jim Hambright's presentation, I do not recall . . .

George Ferreri: Well he did not have it for all sources and he certainly left me out which may be just as well, he figured I was going to show him up so he wanted to leave me out. But I think I should contend that that be done so we could get a better understanding of who is doing what in the production of electricity. Professor . . . and one of the premises that he has developed . . . reasonably available . . . then came the ambient air quality data base and we all zeroed in on that and obviously it is beginning to show that that is not the way to go because in spite of the fact that we can demonstrate that we are meeting national ambient air quality standards we are still talking about . . . in some States. . . . where we see the brunt of this problem. So I do not know exactly how you are going to do this but apparently we are going to have . . . In some way shape or form we are going to have to start gearing the act to address the need for effective utilization of reasonably available technology regardless of whether you are below the ambient air quality standard or not. I would like to suggest that EPA bite the bullet and start enforcing wherever appropriate the implementation plans. We should all recognize we all have our political problems. I think in certain cases without mentioning any names of any States, EPA has bent over backwards to bite that bullet. We in the Northeast who have had aggressive SIPs with rather low sulfur emission limitations are paying for it, and I do not think it is fair, the burden that is being placed on the States on the Eastern Seaboard. One other consideration with regard to PSD--here again in the Northern and Eastern States since we have most of the oil-fired plants--is that we are going to have to get them converted to coal and we are going to be penalized as far as PSD goes. For instance, a 1% sulfur oil going to 1% sulfur coal is going to be a one and one-half times increase in emissions of sulfur oxide. I recognize the acid rain problem, but I want to keep that separate from this PSD issue. What I am saying is, whatever increase in groundlevel concentrations that is caused by converting to coal should be included in the baseline if that plant meets the SIP that was in effect as of August 7, 1977. Going on to the acid rain problem then, let us address it as a technology issue and deal with it across the board rather than through the PSD.

Stanley Pack of Connecticut: Let me say right at the outset that we vociferously oppose any moritorium on SIP revision and I will tell you why. To use the venacular of one of the speakers, let me tell you what the State of Connecticut is up against. We have had a restriction on the sulfur content of our energy producting fuels of 0.5, and we have never had a revision in the history since we adopted that standard. It was adopted somewhere in about 1973. We are now in a difficult situation. The EPA, rather the DOE, has come out ordering our utilities to convert to coal in several instances. The Bridgeport Harbor is already under orders. We have anticipated orders for two units at Norwalk Harbor also. We derive close to 50% of our energy needs from our nuclear power plants so we have sacrificed. We have in a sense rolled back the use of oil in Connecticut. I have legislators, representatives of consumer groups, and the utility industry, all pounding a path to my door. They are looking for relief. We have tried to hold the line. They are not unaware of the fine statistics and graphs that we have seen over the last two days, however, what we are saying is that determined effort by some States to continue as they have is not enough. Tony Cortese put it very well. He highlights the acutal cost that the consumers in the generating States are faced with as compared with the cost in our State. I think that is a very good illustration. There is no equality of sacrifice, keep that in mind. We should have an equality of sacrifice, an equality in the sharing of this burden, and so far I see no indication that we are ready to take up our share. What are we facing in this State under the provisions of the Clean Air Act, the chief executive of any States has the right to go in and ask to have emissions exempt from the total loading in the case of coal conversion. I see that happening repeatedly. What we are facing is a disintegration of the real role, the higher level of performance that we have reached in several States. Unless we address ourselves to it and start on that road immediately, hopefully with the cooperation of some of the States who have pointed out why they cannot do it such as cost. These are the same costs that we are facing, exactly the same costs. I have before me now at least 40 requests for variances and I do not want to talk about any moritoriums because we seriously will be looking at these variances. I think what we are involved in here is something that we all should get together, work together on it. Let us figure out what the costs of our power are in the various States of this country, we are all American citizens, we are all consumers, and let us share the burden, and so far I have not heard any of that. It seems that you want to build in some age old costs that relate to 1.5 cents per kilowatt hour while we are stuck with 7 and 8 cents per kilowatt hour. That is unfair. I do not think geography should determine it. I think the natural resources of this country belong to all the citizens of this country and not to any particular State. I would like to put one question to you, Mr. Hawkins. You are very familiar with the implications of the Alabama case on the PSD. What kind of action activates the application of PSD in a State? Is it merely the adoption of the SIP or is it some other action? I have never received a satisfactory answer to that point.

Mr. Hawkins: The PSD program, the baseline for determination of whether sources had to apply, is established by Congress picking up on the EPA regulations. We run the program until the States pick it up, but the sources do apply, and are subject to, PSD requirements and if they have started construction after a certain date and January 1975 is the principal date. The question is: What triggers the baseline that is in rulemaking? Right now we have comments on a variety of alternatives and the reason you have not received an answer is that we have not completed the rulemaking. We have promised the Court to do so by June 2, and a promise to the Court is better than a promise to somebody else. We will try to get it done. With that note I would like recess this session for lunch.

Mr. Hawkins: The limo from this hotel to the airport leaves at 4:00 and we will try to wrap up by then. We will resume. Could I start off with a question of my own, and then I am going to call on the gentleman from

Delaware. I was listening pretty carefully to Dr. Weidensaul's comments and I noted that he stated no adverse effects on soils, agricultural or forest crops, have yet been shown in Ohio. Now aquatic systems are not in that list and I wonder whether there has been any indication of those kinds of effects in Ohio?

Dr. Weidensaul: As far as aquatic effects, there have been no observed effects as far as we can discern due to acidity in precipitation. We have had problems in Ohio with surface runoff from mine drainage from acid mine spoils and have been successful in controlling and reversing the situation in the lakes to where they are now extremely productive. This is a much different situation. Over the time period that acidification of the lakes took place, there apparently was no significant release of heavy metal cations into the water to cause any permanent harm. As far as rainfall acidity effects we have not observed this at all.

Bob French, Delaware: It seems we cannot solve some of the problems that are coming at us in the near future. For the present, I would like to raise some questions having to do with fuel conversion. I may have to put one or two of my neighboring States on the spot, but I think I have known them long enough to do that. It has to do with how we are going to treat these fuel conversion instances that are coming upon us relatively soon and how we are going to treat it at the borders. For instance, George mentioned an additional 50 percent increase in sulfur emissions for those States like Delaware that have a percent sulfur limitation. I think Jim Hambright alluded to the Regional agreement of the three States and the City of Philadelphia on the question of under a DOE order for a fuel conversion project. Well, we know at what increment the PSD does not apply. I presume we would not hear any objections from neighboring States because of those increased emissions under a DOE order. I would like to extend that further and raise the question of interstate increment disputes or the possibility thereof under a voluntary conversion situation by industry. There is also the question of whether or not there really is a DOE order where the notice of effectiveness has not been issued. There is also a possibility that industry could team up with the utilities and agree to build a new, separate unit to supply the energy needs for the adjoining industry. In these situations are we going to be quarreling about increment consumption at each others borders? Then a question for EPA. It would be helpful to know your schedule for establishing a new source performance standard for industrial-size boilers. These disputes could force us into the business of trying to grab at numbers again. You might clarify the PSD requirements under these voluntary fuel conversion situations and the situations where there is no notice of effectiveness.

Mr. Hawkins: There are a lot of questions there. On the PSD questions, the 5-year exemption from increment consumption that is in the statute at the Governor's request is available for facilities which have been ordered to convert. That is a straightforward interpretation. Voluntary conversions would not, in the words of the statute, fall within that. The other question on the industrial boilers schedule: Is it still a proposal in this calendar year? Walt?

Walt Barber: Yes.

Mr. Hawkins: Proposal of an industrial boiler new source performance standard in this calendar year, promulgation in the next.

Bob French: One question. Just to question your response, that 5-year exemption: Is that five years from the date of the order?

Mr. Hawkins: Well, I don't remember.

Bob French: It is a key point because it gets back to this notice of effectiveness. The date of the order, a couple or three years ago, perhaps but the notice has never been issued. So when does the five years start?

Mr. Hawkins: I will tell you a common sense reaction which may or may not be the way it will wind up. It seems to me that it would be five years from the date at which you would normally be consuming increments. That's a kind of detailed question and a look at the statute can give an answer to it. Rather than try to do that now, we can get back to you and anyone else who is interested. Did Bob Collom have a question? I don't think anyone has yet picked up on Bob French's invitation to respond to the questions of PSD increment consumption at the border but maybe Bob's proceeding to do that.

Bob Collom, Georgia: I would just like to make a few observations and comments. I have heard a lot of "you guys/us guys" comments basically between the Northeast and the Midwest. I think that we all agree there is some degree of acid rain problems created where they exist. The degree and the mechanism is still not totally understood. I don't see why we cannot agree on what can be shown almost cost-effective by itself in the way of either coal cleaning or other mechanisms that might work in certain regions. If necessary, change the Clean Air Act so a regional approach can be allowed without one State taking the full burden of the cost or the inconvenience of taking whatever action is cost-effective.

Obviously, coupled with that, we need more ambient monitoring as well as effects research. We don't need to go pellmell. I don't think we know the solutions. We could not write a new law today or even next month to solve what we think is the acid rain problem. I would comment that PSD in my opinion would get in the way of an awful lot of the alternative solutions that have been offered today. I think it's a shame that one part of the Act is so intransigent, that through the law itself or the regulations or administration of it, that it may eliminate very good alternative solutions to another problem which is more real. More effects can be linked to it than to PSD which are primarily aesthetic effects. I would also ask that people try to define their terms. Coal washing has been bounced around a lot today and obviously there are different types of coal washing, different degrees of effectiveness, and different costs. It varies from mine to mine, types of coal, not just sulfur content but ash content, and also things such as low sulfur-high sulfur. I suspect that means different things to everybody who use these terms. I would think that if education and some consistent definitions and bases could be established, possibly by EPA, and I think EPA has been sort of lacking in establishing any real leadership in this or many areas. Obviously, it's politically sensitive, the answers are not readily available, but we can, at least, educate each other and get on a common ground of definitions of terms and the like which I don't see existing today.

Mr. Hawkins: Yes, from Pennsylvania, Mr. Middendorf.

William Middendorf, Pennsylvania: I would like to try to accomplish several things if I could. One, to perhaps give you the perspective of a coal-producing State that is geographically in the Northeast, and therefore, shares some of the problems that have been raised by the Northeastern States. Secondly, since we are a major coal-producing State, we have somewhat the same problems as the other coal-producing States. The other thing I would like to accomplish is to put into perspective where we are now as a group. We have spent a great deal of time discussing what the technical problems are in facing the reality that yes we do have a problem. We have discussed the political situation--that in the Northeastern States we have a number of States that have bent over backwards to comply with the Federal Clean Air Act because they felt that the Act meant exactly what it said. We have a case where in the Western or Midwestern States compliance has not come about as rapidly or at least we certainly have a difference in emission rates in comparison with the Northeastern States. So we have a difference of opinion on just how tough the standards are and what the impacts are. Being a coal-producing State, I would like to give you the realities of life from our perspective. We have tried to comply. We are geographically located in the Northeast as I said before. We have reduced our sulfur output. We feel that we certainly have a tough political situation especially if we have to go back to our coal miners or our utilities and say that you have to tighten up even more when we have States to the West who are also coal-producing States that are not doing the same job. So if you want to swallow a tough political pill, try the one that we have where we must constantly defend. Why we have been tough and yet are achieving in many instances the national ambient air quality standard and in some instances we are not because of the influence of the neighbors to the West. It is more than apparent as we listen to the discussion that is going on today that each one of us has its own parochial interest. We defend those interests. Those are the realities of life. It should be equally discernible to everybody here that you cannot have your cake and eat it too in all instances. What is going to be needed is exertion of some leadership at the national level; of taking some of the political heat that we all face back in our own States; of saying that we are going to have to tighten up in certain instances. But not to go ahead and grab, shall we say, technical solutions that are applicable across the United States, that are going to make it tougher for those States that have already tried to comply. This means that you can't just grab coal washing as the permanent solution equally across the United States. You cannot grab the idea of retrofitting all existing plants equally across the United States because then you are putting an unfair burden again on those States that are attempting to comply. It is time for EPA to start setting the example by stopping the relaxations that have been going on, by beginning to realize that one State does affect another, that through the SIP process that we have right now, you cannot allow a situation to exist where you simply approve the SIP with no recognition being given as to how one State impacts another State. One of the greatest fears that the six States had when they went to see Mr. Costle about the problem initially, was that when he mentioned this particular type of conference that the States would be thrown into a pit, each sitting there defending what their parochial interests are; each showing the political realities of light from their particular point of view; and then EPA throwing up their hands and saying, "My gosh! If you people in this room can't agree on the solution, how do you expect us, EPA, to do so?" We do expect EPA to do so, we do expect EPA to take the leadership, and I think that every State in this room will pledge to sit down and work cooperatively with EPA in arriving at those solutions. One of the first things that can be done under the law that now exists is to get some of these States that have avected border pollution problems to sit down and work out reasonable solutions as in the case of Philadelphia, New Jersey, and Pennsylvania. All the rhetoric aside, I think the time for action is now.

Mr. Hawkins: Perhaps just a short response is in order. I fully agree, and I know that Doug agrees, with Bill's comment that it would be very inappropriate for EPA to throw up its hands and point to all the States and say we demand unanimity of views among the States before EPA is prepared to doing anything. That would be an unrealistic expectation if we held it. But, we don't hold it, we don't expect there to be unanimity of view. I think that what we have seen is that the States, for very good and proper reasons, do have different perspectives. You have coal-producing States, you have oil-consuming States, you have States which are able to document effects, you have States which are not yet able to document effects. There is a mix of costs and benefits which, at least at this point, aren't perceived to occur in the same places. We understand that and I think it's our feeling that it is our responsibility to see what can be made of that situation that will lead us all in a positive direction. We are going to pursue that with vigor and I think with a lot of ideas generated out of this conference. I do not want to try to give you the summary of the conference before we finish the discussion this afternoon, but I think it is a point well taken. Let me jump to Wisconsin, Tony, first. Wisconsin.

Mr. Dawson: My name is Tom Dawson. I am an Assistant Attorney General of the State of Wisconsin and have been designated as a public intervener, which is an environmental public rights advocate in the State. I have a question, but I would like to preface it with an observation. This part of the discussion, supposedly, is aimed at alternative strategies for solutions to the acid precipitation deposition problem. Mr. Hawkins, you listed several alternative strategies that might be implemented. Mr. Goodwin listed some of the political realities connected with those strategies. I assume that there is no one exclusive strategy that would be advisable or should be advisable exclusive of any other. I take it that when we talk about alternative strategies we talk about an interdisciplinary approach to the solution to this problem. With the assumption that this is going to be an interdisciplinary interrelated solution seeking idea, I wonder why there has not been discussion of what I consider to be one of the central issues to this acid precipitation problem. That is, one of energy policy itself. It seems to me that solutions to acid precipitation and air pollution should necessarily include a discussion of energy policy at both the State and Federal level. My question is why this has not been considered part of that interdisciplinary approach. Again, I am not emphasizing that conservation or alternative energy stategies are an exclusive means of answering this problem, but I am asking why these questions have not been included as one of the many factors that may go into that interdisciplinary approach to solving the problem? Are the DOE people here and are there DOE people who might care to respond to my question?

Mr. Hawkins: There are DOE representatives invited and I think DOE and EPA both believe that energy conservation needs to be pushed as far and as fast as it can be. I personally came to this meeting with the assumption that that was the case. I would also come to the meeting, however, with the personal concern that if history is any indication, we cannot count on a large near-term reduction due to conservation. Except the conservation that seems to be induced by the market changes which we have been seeing in the last 12 months. We certainly need to keep on talking about the benefits of conservation and obviously they are directly there. Any Btu of energy that is not consumed is not going to have any externalities associated with it.

Mr. Dawson: But then we come back to the issue of leadership in the area of conservation and in the area of alternative energy sources; the lack of a cohesive and comprehensive energy policy that must be the basis upon which we create these other solutions; and the issue of trying to anticipate what the demands for coal, for nuclear energy, and the other forms are going to be and how we are going to respond to those demands. Especially in the long term. I guess I am basically speaking to the long-term rather than just the short-term.

Mr. Hawkins: The logic of everything you are saying is unassailable. The thing that a lot of us have observed is that mandatory energy conservation programs seem to be one of the areas that Congress is most sensitive about, and has the most difficulty getting through in any form that does not wind up having little effectiveness because so many special groups have gotten their exceptions identified. The Administration has had a difficult time getting real energy conservation programs through Congress, and those in Congress who have tried to get real energy conservation programs through have also encountered that same difficulty. It does not mean we should stop trying. Ray Robinson asked me some time ago if he could be recognized for a moment.

Mr. Robinson: Thank you very much Mr. Chairman. I might make an observation before asking a question. Some time ago when we were first briefed by the U.S. authorities on some aspects of the acid rain problem, particularly the projections for increases in the emissions of SO_2 and oxides of nitrogen over the next few years, it was put to us that one of the factors that would bring down SO_2 emissions toward the end of the century or early into the next would be the retirement of old plants. Since then we have seen skyrocketing interest rates, and I am interested to know from people who are far more knowledgeable than I am about this subject, as to what implications that might have for retirement projections. Obviously it is worrying from the standpoint of retirement projections. I might make the further comment that the projections we received at the time, while showing that SO_2 would go up 10% and then start to go down in the next century, showed perhaps a doubling of NO_x in that same period. We have had almost no discussion at all of NO_x except during some of the technical discussions earlier in the day. That is very troubling too. By and large, our situation in Canada is that while we have significant SO_2 emissions our NO_x emissions are very much smaller in proportion. We are determined to go after the SO_2 emissions and I am confident that we are going to be able to bring them down. We do have a happy situation in that the principal polluters are located in the Provinces where many of the effects are taking place, and I realize that is part of your difficulty here. That has become very obvious. But, nonetheless, the fact remains that we could be facing a situation in which we take significant action to bring down our SO_2 emissions and yet with a reduction in retirement expectation for some of your power plants, which I am assuming might well be the result of higher interest rates together with what seems to be a lack of concerted approach to the NO_x problem. With respect, ladies and gentlemen you may be occupying the territory we would be vacating, and that is no small matter. We are very concerned about that, so I put that before you as something that might be kicked around a little bit.

Mr. Hawkins: Not too hard. Anyone want to offer any observations on that. Tony?

Mr. Cortese: Thank you Dave. I am getting very concerned that we have spent a day and a half here and as the witching hour is approaching people are getting up and leaving and I think it would be a genuine waste of the taxpayers money and a genuine waste of all the talents and the great debate that has gone on here if we don't talk for a minute about a process to continue this. We are just not going to settle a problem of this magnitude in one afternoon and I would like to suggest for the groups consideration to include Mr. Robinson's concern that we form some subset of this group--I am indifferent as to how it gets set up but obviously representation from every region--to work with you, Dave, and Doug at the highest levels of EPA maybe taking the New York proposal as an example. To get together and work on some real possible solutions to this problem with the concept of coming back in the near future, say the next two to three months, with some proposals on what actions we can take. We have a New York proposal which many of us agreed could serve as a starting point. I would suggest we look at the back-out legislation to consider the issues that I raised before about the rate structure for electric utilities and the use of local coal. I am saying this in the spirit that Bob Collom raised, which is one of trying to sit down and cooperate to find some solutions as opposed to just a continuing debate between different regions of the country. What I would like to do is throw this out for the consideration of the group. I think EPA has made one good suggestion on the idea of coal-washing and getting some information from the States. I think we have got to take some action, and I think that action--in the absence of suggesting a control strategy that everybody can agree to in the next 45 minutes--should be that we do form some subset of this group to get together to work cooperatively to begin to settle this problem. Also to help EPA outline the research program that they have initiated in looking into this problem in the future. I would like to get some reaction from the group on that.

Bob Flacke: Dave and Tony, I would agree wholeheartedly that there has to be some continuation of dialogue, especially the dialogue that was given to us by EPA to interact with our Midwestern States. There is no question that we have regional parochial interests here. Hopefully, the original Six State Coalition that worked with Doug toward the formation of this meeting will expand itself and continue its effort by working with their Congressmen towards an understanding of the Northeast's position on the oil back-out legislation and the impending changes to the Clean Air Act so that we do not continue the lack of equity that has clearly been emphasized by the Pennsylvania/Ohio border situation. I am hopeful that we can use . . . EPA really to kind of schedule some dialogue with the Midwestern States who have taken the opportunity to invite some of the Ohio delegation to visit New York and to go up into the Adirondacks. We have already scheduled with some of the Pennsylvania people to take a trip to the 100 lakes and find out exactly what is happening along with some of our specialty fruit crops and if anybody wants to go along with Ohio, we will be happy to take them along on that trip. So I know that what we will be doing is working with Tony, New Hampshire, Maine, and the original coalition towards organizing some type of formal structure. If we are not able to resolve these parochial interests then we do have to strengthen the power that we do have within those various localities so that we are insured that during the legislative process we do not have a continuation of inequity that is now quite apparent under the current Clean Air Act. I pledge ourselves to work together to continue that dialogue and hopefully then we will be able to work with EPA to continue the dialogue that exists around the table here today.

Bob Collom: I would like to second what has been said here recently, and the STAPPA resolution that was presented this morning although broad and conceptual. I haven't heard anyone try to take it apart. The New York proposal which I understand is endorsed by several other Northeastern States goes further and puts a little meat on the concepts that the STAPPA resolution contained if the definitions can be pinned down, words like significant, equity, or inequity. Then I think we have something that we can use if not through actual legal and regulatory bases with the concurrence of a major group such as this representing State air pollution agencies, departments, representatives from the Governors offices sitting around the room. If there is a consensus there even before any legislation goes through Congress, I feel certain that action can and will be taken. People are not out to cut each others throats. We do recognize the interrelationships we have with one another. If a problem is already occurring in New York, it could well occur in Georgia or Wisconsin or what have you. We are paid to prevent problems and certainly it is a lot cheaper to do that than to cure them afterwards. I would recommend Tony's suggestion and say that in the next three months, if not another meeting of this magnitude since it is hard to get this number of people together, at least regular mailings from a core group of State and Federal officials that promote and keep this going with some initial easy control strategies being proposed within the next four months.

Will Brown, New Hampshire: We would strongly support Tony's suggestion and I would like to ask a question. Does EPA have it within their existing authority to set up a State advisory board on acid rain, or would this require Congressional action?

Mr. Hawkins: Well I don't think that it would require Congressional action, I think if it were an official advisory committee, it would require OMB approval, but an informational advisory group, while it may be subject to the advisory committee act could probably established without that formal approval. There are a couple of procedural questions and they are: How would the group like to have this core group established? Should we try now to identify three or four States which would then among the four of them decide how big an advisory group to select and try to have some balance among that four? I could think of four that would at least to me appear to have a balance. Do we want ask STAPPA? I notice Del Rector is not here, so that is a logical choice. Do we want to ask STAPPA to identify a group of States with some instructions that they be balanced among coal producers, Northeastern States with demonstrated impacts, States like Georgia that may be a little bit of both, States like Pennsylvania? One possiblity is to have the States of Massachusetts, Pennsylvania, Illinois, and Georgia be a core group which can expand to a large core group. I can throw that one out and see if anyone wants to modify that by changing those four States to some other States. What process would people like to follow?

Jim Hambright: If I may Dave, we could sit as a core group and gripe and complain to each other forever and not get anywhere. We really need to have some group in EPA working toward solutions that can be achieved with our participation in their deliberations and trying to aid them and to explore what we believe to be feasible that they come up with and to broaden or maybe to work within that concept. I cannot see this as States getting together to solve this problem because it just isn't very likely to happen. We need to have that national presence, that national guidance, that national development, of some type of a program which would be equitably applied across the country.

Mr. Hawkins: Yes, can I just say, I hear you very clearly on that. I will say again, that EPA's intention is not to say to the State, go sit in the room and figure out the solution and when you have it come back to us. What I heard as the value in Tony's suggestion, and in Bob's reaction as well, was that there is a possiblity that groups of States may perceive themselves as being further apart on these issues than they really are. Any leadership that EPA attempts to exercise is going to make it more difficult to produce successful results if there is a perception that there is a very definite political split, or a split in interest between groups of States, and that EPA is going to have to come down on one side or the other. I think it is in all our interests that there be communication between the States where this perception may be present to find out how much of it is real because if you are closer together it will be much easier for us to do more than pound the table and demand action and quote "exercise leadership". We are prepared to exercise leadership, but I would like to have some positive results come out of it as well. Bob.

Bob Flacke: Dave, I would like EPA, you or Doug, to respond to what we have called the coalition position. Although kindly referred to as New York's, I believe Connecticut wrote the summary; Massachusetts negotiated items 1 and 2; and Pennsylvania did not leave the room at all until it was written (afraid that wrong words would get in); so I really cannot say that the entire idea or even the result is New York's. As a matter of fact I think New York agreed with everyone else. That is a proposal. It is on the table. We really want everyone to look at it. We really want the coal producing States to take a look at it. We are willing to modify those proposals. Frankly, I think that is a start. Maybe the next step would be to take that coalition and continue to negotiate them with EPA within a reasonable length of time, say 60 days, to see if we can get some kind of response as to the next direction that we should be taking. I offer that as a very positive first step.

John Daniel, Virginia: There are several comments I would like to make. One, I would like a summary of this meeting if at all possible. . . list of those States that are in favor of those proposals that are on the table and those that are not, the names of the representatives from those States and whether they in fact are authorized to commit their State one way or another. I guess the other question that I have is: Has EPA, and this goes back to something that Dan said this morning, has EPA considered going to the Nuclear Regulatory Commission (NRC) to get them to speed up licensing of nuclear plants that are already planned because obviously that is one way to minimize the SO_2 problem. The third question is: Is EPA actively supporting the President's coal conversion program?

Mr. Hawkins: A variety of questions there. We have not, to my knowledge, petitioned or tried to induce the NRC to speed up the licensing process. Our involvement in the Three Mile Island incident was sufficient to make us feel that there is good reason for NRC to be taking a good hard look at its procedures. Personally, I have not come to the conclusion that that hard look at its procedures has been dragging along for an unduly long time. With respect to the coal conversion proposal, the Administrator has testified publicly on a number of occasions that he would have preferred an approach which would not have raised the issue of increasing emissions and possibly making the acid rain problem worse. The President's decision was to do something about acid rain after further discussions with Congress rather than trying to do it in the context of this particular legislation. The Administrator has testified that he does support coal conversion and supports legislation that will speed the process, and he has been pointing out the reality of the fact that actually getting that coal burned is going to depend on the political willingness of the communities where the coal is sought to be burned. That means making the perception of coal being burned there something that is acceptable to these communities. Obviously, price differentials help a lot but it is not clear that those by themselves will carry the day, if there is active neighborhood concern about the problems, Bob.

Bob Collom: I would like to suggest that the National Governors Association be involved in this deliberative group over the next few months. We have all heard the political and economic factors that come into these decisions. Most of us around this table are agency people, we do not make the political decisions and do not deal with the legislators on a day to day basis, this is what the Governors have to do. I believe the Governors Association has a subcommittee and a committee structure already set up that would be more than appropriate to assign this sort of topic to. STAPPA does have some experience working with the Governor's Association in such technical issues and I am sure EPA does as well.

George Ferreri from Maryland. Dave the few words you just mentioned causes me considerable concern. First of all I would like to apologize to the State of Connecticut, I was willing to amend my recommendation that their . . . be allowed to . . . Since I think Pennsylvania seems to agree with my recommendation that a SIP moratorium be implemented, I would like to ask you: Do you feel that under the existing laws you have enough authority to implement a moritorium on SIP revisions. I think it is very evident we are going to get to coal, and in order to get to coal in a more expeditious, practical, feasible manner there is going to be a lot of provisions to relax SIPs in order to facilitate this conversion. I think we are all going to be placed under the gun to do this and somewhere along the line someone is going to stand up and say no. Now does EPA feel that under the existing law you have the authority to place a moritorium on SIP regulation?

Mr. Hawkins: Well let me answer by saying there are too many lawyers taking notes for me to want to give you a legal opinion. So what I will say as a policy matter, is that I think it is obvious that there are distinctions that can be made in SIP changes. There are distinctions that can be made in terms of the size of the emission difference that is involved; what level you are going from; what level you are going to; and whether you are dealing with an actual emissions increase or an allowable emissions increase. All of those things are distinctions. They all have a substantive difference on the acid rain concern that we are talking about. So as a policy matter, any policy on evaluation of SIP revisions as a method of dealing with this problem would have to take those kinds of differences into account. You want a follow up question, George?

George Ferreri: Another observation here. We all recognize the Clean Air Act as it is structured which says meet the ambient air quality standard. There is no other consideration in it for what we are discussing right now and that is why we are in trouble. I want to remind you of a situation that occurred back in 1973 when the first oil embargo hit us. One of EPA's officials went about indicating that the reason we were in trouble was because the States were overly aggressive and consequently did more than what was necessary to meet the intent of the Act. On that basis, a lot of us had a . . . I was one of them. We had a one percent sulfur regulation in our State and we had them adjust it to be more reasonable to meet the intent of the Act. I think this is one of the reasons we are here today. We recognize that meeting the ambient air quality standards is not the only thing we should have been doing, that there were other considerations which we did not take into account. That is why I am asking that if the Clean Air Act remains the same . . . the ambient air quality standards that we are going to exacerbate this problem just as sure as I am sitting here talking into this microphone because they are going to request SIP relaxations under the Act as everybody interprets it right now. There is nothing anybody is going to do about it unless somebody is willing to stand up and say we are not going to because there are other considerations that we have to take into account. That is something that EPA, it is going to be in your hands because we cannot do it unless you people do.

Mr. Hawkins: Let me just say that this morning I did try to go through a list of possible options, techniques, that could have an influence on total loadings. Those are options that the Agency is going to be deciding as to whether there is potential to use them or not. I am going to be deciding that in the next couple of months. Did New Hampshire have a question? No? Tony.

Tony Cortese: I am reminded of the First Continental Congress in which North Carolina kept yielding to South Carolina. I would like to get back to the issue, with all due respect to my friend from Maryland, of forming a subset of this group to do something. I would like to hear what other people think. We have had some suggestions about getting together with the NGA; Virginia had suggested to reacting to the proposal I incorrectly characterized as being put forth by New York. I would like to suggest that maybe the STAPPA Executive Board designate some group of people in each Region and go back and consult among themselves to appoint one or two people. We would like to have input from as many of the coal producing States as possible to try to work out something that would be mutually acceptable to all of us. Use our proposal here as a basis for figuring out what could be done in the short run and take off from there, get some response from that. Then consult with the NGA and consult with other groups including Congress on what might be the potential solutions to this problem. The only modification I would make to Bob is that I am afraid if we don't convene some group like this again that we won't be able to make this thing go forward. I would like to view ourselves as the board of directors and some subset of this group should work with EPA to come up with some proposed solutions and try it out in their own States and them come back and make suggestions to this group again at some definite time period whether it be three months or two months or what have you. I am indifferent, as long as it is in the short-term rather than the long-term. I would like to hear some reactions from some of the coal producing States on this idea.

Mr. Hawkins: Carl?

Carl Beard: I'm not reacting to you Tony. This is just a suggestion. There are people you are not hearing from which you are going to hear from. You are not hearing from coal folks; you are not hearing from utility people; you are not hearing from miners. While I agree with Tony's suggestion on a subcommittee, EPA cannot wash their hands. I have very strong doubts that the States will every get together on the economic . . . EPA has to be involved in this process; it's pure and simple. My recommendation is to the opposite of that. Call a meeting, call a conference, but broaden it and give the other perspective. Get them on record. You are going to hear them sooner or later, why not sooner?

Mr. Hawkins: Any other reactions to Tony's suggestion. Dan?

Dan Goodwin: Yeah, I think some kind of an amalgam of several of the suggestions that have been made would perhaps be the best course of action. I think having STAPPA designate some kind of an advisory group or a steering committee of some sort charged with defining what our short-term and long-term objectives ought to be and some plan of action geared to the timeframe of the objectives, I think that would be appropriate. That is something that could be done, I am not sure in two months, Tony, but in six months. I think it should be done with the participation of U.S. EPA and consultation with the utilities, the coal interest, etc. I also think that there needs to be another round of the kind of discussions that we were having here today in a fairly public forum where that group, call it whatever you want to, can come back, bring the ideas that they have come up with in a less public and less intense sort of forum, back to the group. Hopefully, the ideas will have sorted themselves out into a manageable number of issues and suggested actions that can then be taken up by U.S. EPA as a proposal that reflects consensus where it exists and well defined disagreement where consensus does not exist. I think Bob Collum's idea of involving NGA is a good one but I think the State air people need to do some work on the problem first before we get

NGA too actively involved, so that they will have the benefit of our sorting out of the problems before they start on it.

Mr. Hawkins: Yes, John.

John Daniel: I would just like to say, before the comment Carl Beard made because I think that the . . . the input from the coal companies and the utilities . . . it may be just a little unfair to say this, this is a sort of one-sided meeting and I want them to be able . . . and I think it would be a lot more beneficial if we could get in a meeting with them, and discuss this issue further.

Mr. Hawkins: O.k., the woman from Kentucky.

Nancy Osborne, Kentucky: I think if you are going to involve these outside groups, you ought to also get together consumer groups, because they are the ones that are going to bear the brunt of this anyway, whatever solution we abide by, we have got to involve those people.

Mr. Hawkins: Any other, yeah Craig.

Dr. Weidensaul, Ohio: While we are throwing different kinds of things into the pot to consider for whatever kind of a meeting that transpires in the future, I would just like to reemphasize the point that was made and dwelt upon for a significant time yesterday and was not mentioned since midafternoon yesterday, until Ray Robinson mentioned it here before lunch regarding NO_x. By the way I am not trying to get away from the subject of sulfur, I am adding something to the subject of sulfur. The air trajectory data shown in the graphs and so forth showing the mixing patterns and effects of cyclonic and anticyclonic patterns, I think shows pretty clearly and this is I think generally accepted among meteorologists, that there is a tremendous amount of mixing of whatever is in the air and often it is not inconceivable that what Ohio generates, Ohio receives, again the same thing happens in Pennsylvania, New York, and all the way down in Kentucky and Tennessee. It is not restricted to the Ohio River Valley. It is not restricted to the coalition States if I may refer to them as such in the Northeast. What is generated in one particular area does not necessarily go in the direction of these prevailing winds relative to the jet stream, such as we heard yesterday. I would like to throw into the pot the serious consideration of oxides of nitrogen. Along with sulfur oxides, it was considered as one of the two major contributers to acidity in precipitation. There are others such as hydrogen chloride gas, hydrogen chloride, and various other acid gases. But NO_x and SO_x were considered the two primary contributers. Further, I think the data showed rather conclusively--at least I was convinced--that the importance of oxides of nitrogen relative to the important of sulfur oxide is increasing, and is projected to increase quite substantially in the future. I think any effort made to consider limiting emissions from wherever would be remiss if the other primary contributor to acidity is not considered. There are reactions, interactions among these components of rain in the ambient air, and people from the Northeast would agree that the NO_x generated primarily by the internal combustion engine is mixed with materials in their area often transported in the opposite direction from what we recognize as the prevailing winds, mixed with the good things that we can produce in the Ohio River Valley, transported across the Great Lakes, given to Ray Robinson and back up to the Northeast. It is not a simple thing, and I think to just pick out one segment of the pie may be limiting the effectiveness of the entire strategy. I would like to hear a response on the part of the Northeast States relative to the mobile sources of NO_x. It is a tough one to get at, I do not deny that, but nevertheless, they are there, the preponderance to NO_x emissions are in the Northeast, the megalopolis from Boston to Richmond. How do these things fit into the picture of control strategy relative to limiting emissions contributing to the acidity of precipitation?

Mr. Hawkins: Bud.

Bud Hovey: O.k., if you looked at the STAPPA proposal, we did not limit the proposal to sulfur dioxide, we talked about all transported pollutants. NO_x and nitrates are transported pollutants. We recognize that there is NO_x from motor vehicles. We concentrated mainly on dealing with stationary sources. The motor vehicle provisions of the Clean Air Act should, if Congress does not keep relaxing them, eventually start dealing with the issues of NO_x. There have been a number of relaxations on the part of NO_x over time and the motor vehicle industry obviously is trying to get more relaxation so they can put more diesels on the road. I think this is an important issue for EPA to address because we agree that it is probably an important part of that whole mess that causes acid precipitation.

Dr. Weidensaul: I agree, and in response to that I would like to say that here we were either facetiously or seriously alluding to court action in the coal producing States of the Midwest, and it seems we were trying to regionalize the emissions. What I am pointing out is that no one is sitting in an ivory tower. Regardless of whether they are stationary sources or mobile sources, we have got a mix, and you mix with us, and we mix with you, and I do not think it is anyone's individual problem, whether they are mobile source, stationary sources, or what have you. We are talking about compounds in the atmosphere such as oxides of nitrogen and oxides of sulfur. I fail to see the relevance of who drives what car or the fact that it is a mobile source or that EPA has relaxed standards or whatever. We are talking about the effects of acid precipitation, and that if we are going to dig into solving the problem and looking at the contributing factors to acidity, that we would not be properly and objectively addressing the whole problem if we did not consider all the constituents, regardless of their source of emissions.

Bud Hovey: I think you completely missed the point. We are not saying that something should not be done about mobile sources, we are saying they should be. But we are saying that there are a lot of stationary sources; that there is an inequity problem; that there are a lot more emissions from stationary sources in some places than there are from others; that that ought to be looked at very carefully; that the SIP process itself does not work and because of that there seems to be a need for change in the Clean Air Act. To address the issue of treating these sources on an equitable basis in terms of some kind of emission technology, whether we are talking about an emission limit, or about the plan that Dan talked about where you use technology related to the total megawatts generated, or what have you, we are talking about some kind of technology not only for the utility industry, that is probably the first step because they some of the biggest sources, but there are others. Incidentally I agree with something that Carl said earlier that we cannot neglect industries that we have been talking about, the coal industry and the utility industry. Whether you can bring them into the group meeting we were talking about, or whether you are going to have to go outside and set up a separate meeting at some time with these industries and the consumer groups and what have you. We cannot neglect that forever. It has got to be addressed sooner or later and probably the sooner the better.

Unknown Person: Are you suggesting that we also contact the automotive industry?

Dr. Weidensaul: Yes.

Mr. Hawkins: New Hampshire.

Will Brown: Perhaps what we need to do is sort out process from substance at this point and stick to process because that is what Tony started us off with. As I see it, what is coming out of the group in various forms is a strong desire that the EPA take clear leadership in establishing an appropriate follow-through mechanism regardless of what form that mechanism takes. I think that is the number one point that we are really after. We cannot decide here what that process will be. We have all sorts of suggestions, you are the only central body that can sort those out and make some sense out of them and act on them.

Mr. Hawkins: I have a proposal and it is that we, we being EPA, ask the STAPPA executive committee to identify a workable core group of State representatives that has a balance among the different views as we have sorted them out that have been presented here, and that group make its decision about how it wants to involve institutions other than the State representatives themselves. The group when it gets together would make its own decisions about the processes for involving the variety of industrial, consumer, and other groups such as the Governors Association. Is that something that strikes you as useful? George.

George Tyler, New Jersey: I like your suggestion, I endorse it, but the only thing that scares me now, is that you talk about it in the third person. . . . inviting me to chair it, at least that would be my suggestion . . . some technical kinds of solutions that we have proposed and that you have proposed, we are also on the criteria that Dan Goodwin quite correctly set forth in his statement as to what the necessary prerequisites are for the implementation of those solutions. Are we going to have to address the political problem? Otherwise, we could have the greatest technical audience in the world and we not going to go anywhere. That may be what you meant by bringing in at the appropriate time the other interest groups.

Mr. Hawkins: Well one of the main advantages of such a group may be the flexibility it has in being able to contact EPA and others on an informal and frequent basis. Why don't you let EPA decide whether our being a formal member of such a group would increase that flexibility or decrease it. I can assure you that we want to be an active discussant with any such group. From our point of veiw, it is a group of States that would be bringing in others that would allow us to have a point of contact and one that we would want to be working with, so I would not regard it as something that we would watch go about its business as though it were some separate independent entity that we were interested in watching but rather something that we would be working with. Yes, New Hampshire.

Will Brown: As a minimum, couldn't EPA take the responsibility for being the convener? Otherwise, I do not see how this effort will get off the ground. With regard to STAPPA, they have the advantage of being airborne whereas some of us are water bound, and I would hope that you might consider the water pollution organizations as well.

Mr. Hawkins: O.k. As I say, I am perfectly willing to have EPA write a letter to the STAPPA Executive Committee communicating the fact that it was the consensus of this group that the STAPPA Executive Committee form a group of States. The point about bringing in the water interests and asking STAPPA to see that is done can also be made. Bob Collom.

Bob Collom, Georgia: STAPPA has a committee and it has been meeting for several months and has committed itself to preparing a more detailed recommendation to the full membership when they meet in June. We will continue to function under Bud Hovey's chairmanship and the STAPPA President, Del Rector. As you say we are much more free to contact other groups than EPA without worrying about legal clearances and the like. Certainly we will be more than happy to work with EPA. I think we will need some technical input and comment from EPA in order to effectively make sensible recommendations.

Mr. Hawkins: Well now I guess that raises the question of whether the group that already exists as a STAPPA committee is regarded as a broad enough group or whether it is one that people would want to have made broader. Your views are solicited.

Bud Hovey: I would like to make a suggestion, because as chairman of that group it may not be completely broad enough. We have one representative from Ohio on the group, we do not necessarily have the right mix for this meeting because at least three of the members of that committee are from completely outside this region. I would suggest that since Jim Hambright serves on that committee and also is the Vice President of

STAPPA and currently the ranking STAPPA member here of the executive board, that the consideration still should be given by the executive board as to whether or not they want their committee, which I chair, to do this work, or to augment the committee to do it, or to set up a separate ad hoc committee. I would rather leave it to the executive board to make that decision.

Jim Hambright: I would like to ask a question, Dave. Do you have a legal problem with EPA chairing the group because I, and I think my fellow State representatives, here do not like the concept that we would be sort of meeting alone and then just consulting with EPA. We feel that this has got to be a true State/EPA partnership and that is the only way it can work, and I would like to hear why that cannot be?

Mr. Hawkins: I have no problem at all with the objective of it being regarded as a two way street between EPA and the States. The mechanism for accomplishing that and keeping this to be a workable group is what I would like to identify as the best technique. It may be that EPA membership will be feasible, it may be that it would be better to not have EPA membership, but the objective is not in issue as far as I am concerned. Now as I understand the proposal as it has been modified, we would have EPA writing a letter to STAPPA asking that the executive committee see that a group of core States be set up to work with EPA and to establish procedures for contacting others and involving them and that STAPPA would be asked to look at three options for establishing that group. Either the current group chaired by Bud Hovey, a modification or augmentation of that group, or an entirely separate committee. The letter will not indicate any preferences because I have heard none.

Tony Cortese: O.k., I agree with that, although I would like to suggest that with all the States that are here today, we could, after this meeting, make that decision and let you know by the time you write the letter. I guess what I am saying is that I am not interested in wasting any more time, and I don't want a letter writing campaign that is going to take a month to get back and forth. I would also like to suggest to the group here that we convene again in three months and in effect serve as the board of directors to listen to what has been done in the three-month period, to keep this issue on track, and see where we might have to go from here. What do you think of that?

Will Brown: Why not? I would like to respond to the question the Virginia gentleman asked a while ago, it is a very difficult question, and that is how each State stood with regard to that resolution. Well, New York is gone, I hate to say this after Bob Flacke's departure--it would seem as though I was afraid of him being bigger--but he neglected to mention that the original draft that was submitted to NESCAUM, out of which this document grew, was drawn up in New Hampshire. Your question was how does each State react or respond to that document. It is an impossible question to answer because many of us saw that completed document for the first time today. We have had no opportunity to refer it back to our homeground committees. In New Hampshire's case, that would be the Acid Rain Coordinating Committee which I chair, or, more importantly, our Governors. If EPA or this steering committee that may derive out of STAPPA were to see fit, they could write each State within the next suitable period and enquire how they stand on it, after time for due reflection and determination. That might be helpful.

Mr. Hawkins: All right, we are losing participants and at this time, the schedule calls for summing up, so let me try to solicit a last round of questions. I think we have agreement on the process for establishing a follow-up subgroup of the States, and I would suggest that that subgroup also be charged with the task of deciding whether another preliminary session of the States in three months would be useful or not. George Tyler, you had a question?

George Tyler: I was just going to suggest to you, if you would not mind, assuming the possibility for reconvening a meeting like this inside of three months, whatever happens . . . the subsequent review is worth and also I am not sure I understand the problem that you forsee with EPA participation unless maybe . . .

Mr. Hawkins: I am just being cautious, just being a lawyer.

George Tyler: I understand. Consider that seriously.

Mr. Hawkins: Yes, yes.

George Tyler: Before it gets too far along and then perhaps consider the question of . . .

Mr. Hawkins: Yes, I assure you it does not represent any policy difference with people who do not want EPA sitting on the sidelines holding up score cards that say we will give you a five for difficulty and a six for performance. We do not intend to take that role.

George Tyler: I was just trying to suggest that the solution to this kind of a problem . . . not for any individual solution but just for a solution. Someone to keep pushing and pulling things together and getting people to sit down and talk. Anyone who has a regional interest is not going to be trusted with doing that.

Mr. Hawkins: I suggest that all of you read Doug Costle's printed statement opening this conference when you have the opportunity because you may not have caught all the things he said as he delivered it. Let me try to sum up in a couple of minutes what EPA is going to be doing over the next few weeks. What I heard today did not suprise me. I heard a variety of statements from different points of view. Statements from States which perceive themselves to be the recipients of emissions from other areas, who perceive that they are having adverse economic and environmental effects in their States due to sources which they do not have the jurisdiction to control. I heard statements from coal-producing States which pointed out the political realities of finding a coalition in the States which has an interest in producing coal, in burning that coal to provide electricity to its own consumers, and which has, apparently, yet to identify a collection of adverse impacts in its own State resulting from those practices. Interestingly enough, something that I heard yesterday was not stressed quite as much today, except just recently by Craig Weidensaul, and that is that there may be adverse impacts in the coal-producing States that are not necessarily identified with the aquatic ecosystem acid rain effects that the Northeastern States have been identifying but are identified with the one, two, or several day episodes of very high levels of pollution affecting visibility and elevated pollution levels especially during the summer which can come from almost any direction and can come from States which are not coal-producing States. It can come from States which may be burning coal from a coal-producing State or maybe burning other fuels. So one point that I would find useful to leave with all the States is: what are the possible areas of common concern here? I guess if there was one focus that would be most useful, it would be for each of the State representatives to consider the problem from the perspective of the State which he or she thinks is most apparently on the other side, if you will. In putting together a political strategy for a solution, because a political strategy as well as a legal and a technical strategy is necessary, people have to help answer each others needs. The needs I heard expressed by the Midwestern States were find a way of portraying this so that it does not appear to our constituents to be all cost and no benefits. The needs I heard expressed by the Northeastern States were: find a way to convince your constituents to recognize that we in the Northeast have been exposed to both costs of our own bearing and yours. That we are being exposed to pressures to relax our environmental controls which we do not want to relax because we do believe that there are adverse impacts associated with increased levels of emissions from our own sources as well as from yours. Find a way to communicate that. I think from a State like Georgia or Pennsylvania which tends to have some issues on both sides of this dichotomy, I heard the expression that there are, in fact, States where this clear dichotomy is not present. For all those things, it was not a large surprise, and to EPA it was not a disappointment even, that there would be these expressions of concern. But I think it is important for the States to hear them said directly to each other, in a forum that is devoted to that purpose rather than having a hallway conversation at the annual APCA meeting. We at EPA are going to be doing the following things:

° Prepare a report on this conference which will be sent to everyone;

° Prepare a resource document on acid rain and sources, emissions, technical fixes, economic, and social issues which will also be made available;

° Analyze some of the issues that many of you pointed out needed to be analyzed. What is the cost-effectiveness of coal-washing on a regional basis, on a Statewide basis, on a plant-by-plant basis? What is the cost-effectiveness of those techniques versus other sulfur control techniques versus NO_x control techniques. Those evaluations are in process as Lowell Smith indicated to you and in May we will be reviewing them internally and we will be providing them in a publishable form as soon thereafter as we can;

° Expand some of the nontechnical fixes like the dispatch system, the early retirement. That we will be doing over the course of the summer;

° Put together a series of cost-effectiveness analyses that will allow people to look at different techniques, see what they buy in terms of emission reductions and how much they cost, different packages with different costs and a whole range of alternatives;

° Continue the review of our current legal authorities to see what holds promise for some early action to try to move in the right direction on this problem and if we identify something that holds promise, then we will pursue it. We hope we will have that review completed in the next two months;

° Work on legislative options during the same timeframe so that we will not have just one arrow in our quiver.

We are going to put ourselves in the position of having plausible legislative options available either as a backup to current regulatory initiatives or as a supplement. So we are going to be undertaking a number of activities and we will be very happy to work with the States and the various interest groups that we did invite as observers to this meeting. For workability we did set up procedures that had the States be the participants because it was the States that asked for a meeting among themselves. That is where we are proceeding and we will follow the suggestion of this group, that we ask STAPPA to establish a subgroup that would provide a mechanism for the States to keep the ball moving, but EPA will be keeping the ball moving as well and working with you to do that. Tony.

Tony Cortese: I think there is another conclusion that we should also reach. In the past two days, I did not hear anybody say that we should not follow the President's initiative to burn more coal as long as it was done in an environmentally sound manner. I think that conclusion ought to come out very clear. We, the Northeastern States, are not anticoal. We just believe that coal ought to be burned with the proper pollution controls so that we do not endanger either our health, our environment, or our economy. I think that conclusion ought to be one of the ones that is reached as a report of the conference.

Mr. Hawkins: Very well. At the break, Doug Costle, at the break, told me that he had been involved with a White House meeting which he was going to attempt to reschedule in order to come back here and preside over the conclusion. I assume, from his absence, that has not been possible, so unless there is additional statements, and I see Ellis Cowling has one, so I will not complete that sentence. Go ahead, Ellis.

Ellis Cowling: Dave, I think it is important for us to discuss, at least very briefly, the issue of conservation. I am not talking about mandatory conservation but rather voluntary conservation. I think it is remarkable that this subject did not enter the discussions in this room until 2:15 this afternoon. Does that mean that the States have no faith that the American public will respond to leadership on the issue of conservation in the interest of better fishing opportunities? What is the potential for public education that would result in modified behavior in terms of automobile use as Craig was indicating, in terms of their own use of electrical power, on the issues of cogeneration of electrical power, which is a policy that is not found in favor among the public utilities, but is widely used in Europe. I think it is also important for us to realize that our nation is very consumptive of energy. Sweden, with a very similar distribution of population over a land area essentially similar, use half as much energy per capita as we do and certainly enjoy a much higher standard of living than we enjoy in North Carolina. So I would hope that there might be some comments about the potential public education on that.

Mr. Hawkins: George.

George Ferreri: Dr. Cowling I do not think anybody is ignoring the potential of conservation, the benefits that could be extracted from it. I guess if I may be a good bureaucrat, it is not my job to institute conservation, there are other incentives being put forth by the Federal government for the States that develop energy conservation programs which are really the responsibility of other agencies. As far as the conservation of gasoline, the price is going to make people want to conserve.

We have been able to identify enough issues that we can handle, that we have some direct control over to keep us busy for a long time, and again it is not a case of whether we think conservation will work but rather that we have enough problems of our own without trying to take on somebody else's problems.

Dr. Cowling: Is that being done in Maryland?

George Ferreri: Yes it is. If each State could come up with approximately the same reductions, I think we would be eligible for some kind of a bone that they would throw our way.

Dr. Cowling: In terms of percentages we have achieved a 9% decrease in gasoline consumption in North Carolina, now that means a 9% decrease in NO_x presumably. You were talking about near-term options that would make a real dent in the SO_x and NO_x emissions, is it not feasible to achieve 10%, 15%?

George Ferreri: It would be impossible to achieve a decrease in gasoline usage now because the Governor is going to increase the gasline tax to make up for the drop in revenue. We are all suffering from this.

Tony Cortese: Come to New England and see what has been going on for the last three or four years because of the price of fuel and you will see conservation and you will see industries that have cut down their energy usage by 50%, and 40% by homeowners and drivers. If you want to talk about a regional problem, you should see what happens to us with allocation of fuels and basing allocation of fuels on historical records by the Federal government which means the more you conserve, the less you get in the future if rationing occurs. If you want to talk about conservation, we have been there and we will continue to be there as long as the price of oil and fuel is there. I guess that is why we did not bring up conservation. Dr. Cowling, your point is very well taken, we will continue conservation, but conservation has got to be uniform across the country just like environmental controls have to be uniform.

Dr. Cowling: Yes, and I think we can learn from your experience and it might be useful for EPA and the special committee that they are going to be working with to examine such regulatory policies for the attitude of the utilities commissions in States toward the issue of cogeneration.

Will Brown: The best way for an oil dealer to survive in New Hampshire now is to go into the business of installing wood furnaces.

Mr. Hawkins: Well we have appropriately noted the opportunity that conservation presents, it is one that apart from figuring out how to convince everyone to do it, is obviously a very cost-effective approach. I want to thank all of you for coming here. I think the conference has been a good start. That is all it is though, is a start. We told you what we are pursuing at EPA. We have a process established that will allow the States to have a group that can provide a source of contact for EPA and we will look forward to talking with all of you more about this subject in the coming weeks. Thank you once again.